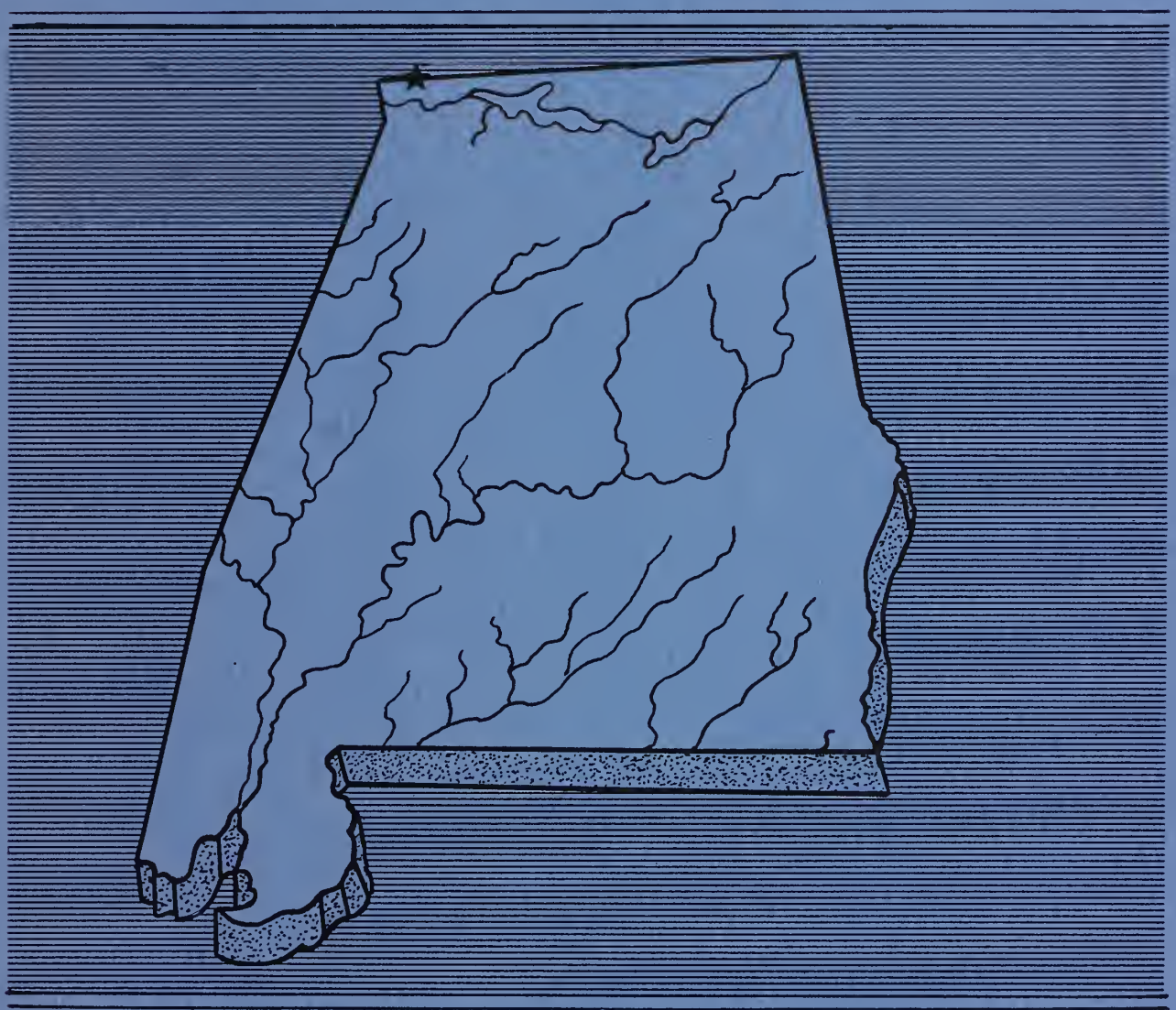
WATERSHED WORK PLAN
FOR
CYPRESS CREEK WATERSHED



LAUDERDALE COUNTY, ALABAMA
AND
WAYNE COUNTY, TENNESSEE

4-31104 12-71
USDA-SCS-FORT WORTH, TEX. 1971

WATERSHED WORK PLAN AGREEMENT

Between The

Cypress Creek Watershed Conservancy District
Lauderdale County Soil and Water Conservation District
Lauderdale County Commission
Florence State University
Wayne County Soil Conservation District
Three Cypress Creek Watershed District
(Hereinafter referred to as the Sponsoring Local Organizations)

State of Alabama
State of Tennessee

and the

Soil Conservation Service
United States Department of Agriculture
(Hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Cypress Creek Watershed, State of Alabama and State of Tennessee, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Cypress Creek Watershed, States of Alabama and Tennessee, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about ten years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. Except as hereinafter provided, the Sponsoring Local Organizations will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement. (Estimated cost $1,031,050). The percentages of this cost to be borne by the Sponsoring Local Organizations and the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Land Rights Cost (dollars)
All Structural Measures	100	0	$1,031,050

2. The Sponsoring Local Organizations will provide relocation advisory assistance services and make the relocation payments to displaced persons as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. Prior to July 1, 1972, the Sponsoring Local Organizations will comply with the real property acquisition policies contained in said Act and Regulations to the extent that they are legally able to do so in accordance with their State law. After July 1, 1972, the real property acquisition policies contained in said Act shall be followed in all cases.

The Service will bear 100 percent of the first $25,000 of relocation payment costs for any person, business, or farm operation displaced prior to July 1, 1972. Any such costs for a single dislocation in excess of $25,000 and all costs for relocation payments for persons displaced after July 1, 1972, will be shared by the Sponsoring Local Organizations and the Service as follows:

	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	31.22	68.78	$23,200

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Construction Cost (dollars)
Multiple Purpose Structure No. 9 Joint Costs	13.2	86.8	$257,627
Eighteen Floodwater Retarding Structures and about 50.3 miles of Stream Channel Improvement	0	100	$3,954,652

4A. The percentages of fire suppression equipment cost to be paid by the Sponsoring Local Organizations and by the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Construction Cost (dollars)
Fire Suppression Equipment	50	50	$4,000

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organizations and the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Engineering Costs (dollars)
Multiple Purpose Structure No. 9 Joint Cost	13.2	86.8	$20,610
Eighteen Floodwater Retarding Structures and about 50.3 Miles of Stream Channel Improvement	0	100	$344,664

6. The Sponsoring Local Organizations and the Service will each bear the costs of Project Administration which it incurs, estimated to be $14,500 and $783,286 respectively.

7. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50 percent of the land above each reservoir and flood-

water retarding structure that they will carry out conservation farm or ranch plans on their land.

8. The Sponsoring Local Organizations will provide assistance to landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

9. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work to be done in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1 - 15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of or be subject to discrimination under any activity receiving Federal financial assistance.

Lauderdale County Commission
(Local Organization)

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Lauderdale County Commission adopted at a meeting held on _____.

_____
(Secretary, Local Organization)

Date _____

Florence State University
(Local Organization)

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the Board of Trustees of Florence State University, adopted at a meeting held on _____.

_____
(Secretary, Local Organization)

Date _____

Cypress Creek Watershed Conservancy
District (Local Organization)

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Cypress Creek Watershed Conservancy District adopted at a meeting held on _____.

_____
(Secretary, Local Organization)

Date _____

Lauderdale County Soil and Water
Conservation District
(Local Organization)

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Lauderdale County Soil and Water Conservation District adopted at a meeting held on _____.

_____
(Secretary, Local Organization)

Date _____

Three Cypress Creek Watershed District
(Local Organization)

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Three Cypress Creek Watershed District adopted at a meeting held on _____.

_____
(Secretary, Local Organization)

Date _____

Wayne County Soil Conservation District
(Local Organization)

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Wayne County Soil Conservation District adopted at a meeting held on _____.

_____
(Secretary, Local Organization)

Date _____

Soil Conservation Service
United States Department of Agriculture

By _____

Date _____

4-31104

WATERSHED WORK PLAN

CYPRESS CREEK WATERSHED

LAUDERDALE COUNTY, ALABAMA

AND

WAYNE COUNTY, TENNESSEE

Prepared under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666) as amended.

Prepared by: Cypress Creek Watershed Conservancy District
Three Cypress Creek Watershed District
Lauderdale County Soil and Water Conservation District
Wayne County Soil Conservation District
Lauderdale County Commission
Florence State University

With assistance by: U. S. Department of Agriculture
Forest Service

U. S. Department of Agriculture
Soil Conservation Service

November 1971

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WATERSHED WORK PLAN

CYPRESS CREEK WATERSHED

LAUDERDALE COUNTY, ALABAMA AND WAYNE COUNTY, TENNESSEE

November 1971

SUMMARY OF PLAN

This plan for flood protection for Cypress Creek Watershed, Lauderdale County, Alabama and Wayne County, Tennessee was prepared by the Cypress Creek Watershed Conservancy District, Lauderdale County Commission, Lauderdale County Soil Conservation District, Florence State University, Three Cypress Creek Watershed District and Wayne County Soil Conservation District as co-sponsoring local organizations with technical assistance by the USDA.

The watershed covers a drainage area of 135,360 acres of which 84,992 acres are in Lauderdale County, Alabama and 50,368 acres are in Wayne County, Tennessee. Lauderdale County is eligible for benefits under the Appalachian Regional Development Act of 1965 and Wayne County is eligible for benefits under the Public Works and Economic Development Act of 1965. There are approximately 13,000 acres of land subject to flood damage. Damaging floods which occur five to ten times each year severely limit production in the flood plain. Proposed project measures will reduce flood damages approximately 80 percent.

Works of improvement planned:

(1) Land Treatment

Measures planned include water disposal systems, field border planting, pasture and hayland planting, wildlife habitat development, tree planting, construction of ponds, and woodland conservation. These measures will be installed during a ten-year period by individual landowners in cooperation with the Lauderdale County Soil and Water Conservation District and the Wayne County Soil Conservation District. The estimated cost of installing these measures is $1,457,300. The P. L. 566 cost is $83,000 or 5 percent and the Other cost is $1,374,300 or 95 percent. These measures will be operated and maintained by landowners cooperating with the Lauderdale County Soil and Water Conservation District and the Wayne County Soil Conservation District.

The 83,418 acres of forest land are all in small, privately owned tracts. The forest acreage breakdown is 52,645 acres in Lauderdale County, Alabama and 30,773 acres in Wayne County, Tennessee. There are no lands administered by the U. S. Forest Service in this watershed. Forestry measures are planned on 5,700 acres of private forest land. These measures include tree planting, release and improvement cuts for watershed protection. The measures reduce storm runoff and stabilize the soil to prevent

erosion and deposition of sediment. Under continued protection and proper management, the forest stands will enhance the future economy of the watershed.

The length of the installation period for the works of improvement is ten years. Technical assistance for applying the forestry measures on private forest land and in urban areas will be furnished by the U. S. Forest Service in cooperation with the Alabama Forestry Commission and the Tennessee Division of Forestry. The landowners and operators will maintain the forest land treatment measures on their lands.

(2) Structural Measures

Structural measures consist of eighteen floodwater retarding structures, one multiple-purpose structure, and approximately 50.3 miles of channel improvement. The Lauderdale County Commission will install structural measures in Alabama and the Three Cypress Creek Watershed District will install structural measures in Tennessee by contract during the ten-year installation period. The estimated installation cost is $6,433,389 of which P. L. 566 cost will be $5,351,311 and Other cost will be $1,082,078. The Cypress Creek Watershed Conservancy District and the Lauderdale County Commission will perform or arrange for the performance of operation and maintenance of the floodwater retarding structures and channel improvement in Alabama and the Three Cypress Creek Watershed District will perform all operation and maintenance in Tennessee. Florence State University will operate and maintain the multiple-purpose structure. Approximately 12,456 acres of land will be benefited by structural measures. The flood plain land has very high agricultural potential and is valued as high as $600 per acre. No significant change in acreage of allotted crops is expected.

Present average annual floodwater damages are estimated to be $279,385. After project measures are installed, estimated annual damages will be $59,416 or a reduction of 80 percent. Total average annual benefits are $594,249; and the total average annual costs are $383,125 giving a benefit-cost ratio of 1.6:1. Total estimated installation cost is $7,890,389 (Table 1). The P. L. 566 cost is $5,434,311 (69 percent), and the Other cost is $2,456,078 (31 percent).

DESCRIPTION OF THE WATERSHED

Physical Data

Cypress Creek Watershed is in Lauderdale County, Alabama, and Wayne County, Tennessee. This watershed lies within the Tennessee River Basin and comprises an area of 135,360 acres. Cypress Creek originates near Collinwood, Tennessee, and flows in a southerly direction through Wayne County, Tennessee, and Lauderdale County, Alabama. The City of Florence, with a population of 37,200 is located near the mouth of Cypress Creek. The creek enters the Tennessee River about 4.4 miles downstream from Wilson Dam.

The topography varies from nearly level in the flood plain to moderately rolling and steep in the uplands. Maximum relief within this

watershed is 300 feet. The lowest point is at the mouth of the creek and the highest point is along the northern boundary of the watershed. The flood plain is about 1 mile wide at the confluence of Cypress Creek and Middle Cypress Creek. On tributary streams the flood plain averages about 0.2 mile.

The main flood plain soils are well to somewhat poorly drained and are in capability classes IIw and IIIw. With good management these soils will produce high crop and pasture yields. Most of the upland soils are in capability classes III, IV, and VI with smaller acreages in classes I, II, and VII.

Principal geologic formations occurring in the watershed are the Mississippian Fort Payne, Mississippian Tuscumbia, Cretaceous Tuscaloosa, and Cretaceous Eutaw. These formations result in deep silty and clayey soils with considerable gravel in the subsoil.

The average annual rainfall in this area is 52 inches. Short periods of very dry or very wet weather are common. Normally October is the driest month and March is the wettest. Thunder storms and intense showers of short duration are common during the spring months. Dry conditions prevail from midsummer to late fall, but severe droughts are uncommon. Winters are relatively mild and summers are warm. The length of the growing season is approximately 200 days, with the last killing frost occurring in April and the first occurring in October. These are average climatological conditions.

The City of Florence, Alabama, and rural-residential developments are the principal water users in this watershed. The Florence water supply pumping station is on the east side of Cypress Creek about 400 feet downstream from the junction of Cox Creek. The residential developments purchase water from the City of Florence.

The present forest hydrologic condition based on five hydrologic condition classes is 0 percent very good, 20 percent good, 17 percent fair, 37 percent poor, and 26 percent very poor. The poor hydrologic condition is a result of overcutting, overgrazing, wildfire, and past cultivation of presently forested lands. Forest growth and hydrologic conditions are expected to improve under proper management and protection.

Economic Data

The economy of the rural portion of the watershed is oriented around the production, marketing, and processing of agricultural products and services. The major farm enterprises are corn, cotton, soybeans, beef cattle, and dairying. Because of the flood hazard, production in the flood plain is limited. The agricultural portion is divided almost entirely in family-type farms.

Land use in the watershed consists of 15,208 acres cropland, 27,309 acres pasture and hayland, 83,418 acres woodland, and 9,375 acres in miscellaneous use. The flood plain is approximately 35 percent pasture and

hayland, 35 percent cropland, 29 percent woodland, and 1 percent in miscellaneous use.

Lauderdale County is in the Appalachian region and is eligible for benefits under the Appalachian Regional Development Act of 1965. Approximately 40 percent of commercial farms in Lauderdale County have gross sales of less than $2,500 annually according to the 1964 Census of Agriculture. About 14 percent of commercial farms in Lauderdale County have gross annual sales exceeding $10,000. Wayne County is designated by the Public Works and Economic Development Act of 1965 as being eligible for assistance. According to the 1964 Census of Agriculture, approximately 56 percent of the commercial farms in Wayne County, Tennessee, have gross sales of less than $2,500 annually. About 4 percent of commercial farms in Wayne County have gross annual sales exceeding $10,000. The farms range in size from 100 acres to about 1,250 acres, with an average size of 200 acres. There are approximately 1145 farms in the watershed.

The value of land ranges from $200 per acre in the upland to $600 per acre in the flood plain. In the City of Florence and surrounding urban area, land is valued at approximately $4,000 per acre. The value of land in the rural area has been steadily increasing because of the expanding rural-residential development in the watershed. The West Lauderdale County Water and Fire Protection Authority with financial assistance from the Farmers Home Administration has installed approximately 80 miles of water lines to these developments. Cypress Creek is the source of water being used by the authority.

An industrial park of 800 acres is presently being developed in the watershed near Florence. Ten industries are now located in the park and a railroad is under construction.

Transportation facilities are excellent. The Tennessee River provides a very economical means of transportation to many areas of the United States. Several state and federal highways cross the watershed, and the Southern and L&N Railroads furnish railway transportation.

Because of rapidly expanding industries of the Muscle Shoals area, excellent buying and selling markets are available for agricultural products and services. The population of the Muscle Shoals area, which is within 5 miles of the lower reaches of the watershed, is approximately 108,128.

The hardwood forest type comprises 93 percent of the forested area and hardwood pine on the remainder. Principal species are white oak, red oak, blackjack, post oak, shortleaf pine, yellow popular, sweetgum, hickory, red maple, dogwood, sugar maple, elm, and beech.

Sixty-five percent of the forest area is well stocked with merchantable species. Sawtimber volumes will average 91 board feet of pine and 733 board feet of hardwood per acre. Pulpwood will average 517 cubic feet per acre of hardwood and 8 cubic feet per acre of pine.

There are no lands administered by the U. S. Forest Service in this

watershed. All forested land is in small privately-owned tracts. The Alabama State Forestry Commission and the Tennessee Division of Forestry in cooperation with various federal-state cooperative forestry programs are providing forest management assistance, forest fire prevention and suppression, distribution of planting stock, and forest pest control assistance to private landowners in the watershed. Under continued protection and proper management, the forest stands will contribute much to the future economy of the watershed.

The largest portion of the watershed is in small private ownerships. The U. S. Department of Interior, National Park Service, administers the Natchez Trace Parkway, which crosses the watershed. The Tennessee Valley Authority owns a small acreage of land in the lower reach of the watershed of which the City of Florence is using a portion to develop a recreational area on. The remaining TVA-owned land has been developed into a wildlife management area in cooperation with the Alabama Department of Conservation and the Lauderdale County Soil and Water Conservation District.

Land Treatment Data

The upland portion of the watershed is relatively steep and considerable erosion takes place during periods of high intensity rainfall. This erosion has been accelerated by some shifting of intensive row cropping from the bottom land to the upland. Many landowners are reluctant to install extensive waterways and terraces because of (1) cost of construction and (2) decreasing field sizes, which are difficult to farm with large machinery and equipment. Anticipated changes in land use consist principally of conversion of woodland to homesites, roads and pasture. Since this is a trend, it will not necessarily be accelerated by project installation. Rapidly expanding rural-residential developments are taking large amounts of unimproved pasture and woodland. Generally, these conversions will be in small tracts involving mostly land capability classes III and IV.

It is anticipated that a substantial amount of the unimproved pasture in the flood plain will be converted to permanent pasture if protected. Much of the intensive row cropping will shift from the eroded upland to the flood plain. With the shift the upland is expected to be converted to pasture.

A study of work unit records indicates that 75 percent of the planned land treatment measures have been applied. There are 259 cooperators in the watershed and approximately 30 percent of the watershed is covered by conservation agreements.

Without flood protection inefficient use of labor, land, and equipment is occurring. The potential of the flood plain cannot be realized because of the flood hazard.

Fish and Wildlife Resource Data

Fish - Principal species of sport fish are white lake bass, largemouth bass, rock bass, redeye bass, smallmouth bass, bluegill, channel catfish, blue catfish, and flathead catfish. Good catches of crappie are sometimes

taken from Cypress Creek and its major tributaries, particularly in the lower reaches. Sauger are also frequently caught, especially during the spawning season.

Fish populations are highest in that portion of Cypress Creek and its tributaries between Rasch Road and Pickwick Lake. There is little fishing activity above Rasch Road except at road crossings.

Wildlife - Wildlife populations generally range from low to moderate. Rabbit, squirrel, and quail are moderate in number. Hunting activity is moderate for rabbit and squirrel.

Dove populations are generally low throughout the watershed, but doves sometimes congregate during fall and winter in some of the larger grain fields. Hunting activity for doves is generally low.

Deer and wild turkey populations are negligible. Deer have been released recently at nearby locations and are expected to increase in number. Fox populations are high. A fox hunting club owns a lodge and kennel in the upper reaches of the watershed. Hunting activity for foxes is generally high throughout the watershed.

Mink and muskrats are low to moderate in numbers. Trapping activity for these species is negligible. Raccoon populations are moderate, and hunting activity for raccoons is moderate. Beaver and waterfowl populations are of little importance.

WATERSHED PROBLEMS

Floodwater Damage

The land along Cypress Creek and its tributaries is subject to frequent and severe flooding because of the low capacity of existing channels. Small frequent storms cause more total damage than the large infrequent ones. Existing channels in the vicinity of the confluence of Cooper Branch and Cypress Creek have no effective capacity.

Damaging floods occur five to ten times each year along Cypress Creek from the confluence of North Fork downstream to the confluence of Lindsey Creek. Along the remainder of Cypress Creek and its tributaries, damaging floods occur two to five times each year.

In March 1955, the most intensive storm of record occurred in the watershed. This flood was considerably greater than the 100-year frequency 24-hour duration storm and inundated 12,456 acres that will be benefited by proposed structural measures. Monetary damages caused by this flood are estimated to be over $100,000. This damage would have been considerably greater if the storm had occurred after crops had been planted.

Frequent damaging floods are severely limiting the potential flood plain production. Floods and related hazards have increased the management problems related to the proper use of bottom land soils. There are some

areas of flood plain that have gone out of agricultural production because of the flood hazards. Some intensive row cropping has shifted from the bottom land to upland. The shift of row crops to the upland has reduced the potential income as well as increased the erosion on upland. The quality of agricultural products is decreased by flooding, resulting in reduced value and cash income to farmers.

Damages to fences, agricultural buildings, drainage ditches, and farm roads are significant. It is not economical to fence some of the flood plain because of damages to fences from flooding. Fence repair and removal of flood debris are necessary several times each year. The creek is the property line in many places. With a different landowner on each side of the creek, twice as many linear feet of fence have to be constructed. This double fencing increases the potential flood damages to fences. Drainage ditches and farm roads are damaged by sediment deposited by floods.

Nonagricultural damages are important because of the number of roads subject to damage and the number of residents affected when a road is damaged. Roads are closed several times a year. Persons living in the rural-residential developments in the watershed usually are employed in the Muscle Shoals area. When a road is closed, it is necessary to reroute a large amount of traffic. Failure of school bus transportation and rural mail delivery are other indirect damages. Road fill material must be replaced and bridge abutments repaired frequently.

During the 100-year evaluation period under consideration, flood damages without project conditions were estimated to be $279,385 annually. Below is a summary of these damages.

Agricultural	
Crops and Pasture	$198,670
Other	30,948
Scour	8,713
Nonagricultural	
Roads and Bridges	15,974
Indirect	25,080

Sediment Damage

Cypress Creek is not an extremely sediment-polluted stream, though extensive row crop farming and rural-residential construction produces fairly muddy water after a rain. Damage to flood plain soils by deposition of infertile soil carried by floodwater is slight. This damage was not evaluated because of the small acreage and amount of damage.

Gravel partially fills the channels in the upper and middle reaches of the watershed causing increased frequence and magnitude of flooding. This sedimentation results from the erosion of moderate amounts of gravelly material from roadbanks, road surfaces, gullies, and other sources. Gravel is rolled along the bed of the creek during storms; a portion eventually reaches the Tennessee River and the remainder partially fills the channel. This sedimentation has occurred gradually over a long period of time and has now progressed to the extent that internal drainage is impaired and

channel plugging is imminent. Severe damage to the flood plain from gravel deposition and swamping will result if the present trend continues. No dollar damage value was assigned to the channel filling, as increased flood heights are reflected in floodwater damage and it is not known where or when the channel plug damage will occur.

Erosion Damage

Sheet erosion accounts for practically all the erosion in the watershed. The natural erosion rate is high. Man-caused erosion has been accelerated by the shift of row crops to the upland and by rural-residential development in the form of roads, streets, housing, and industrial construction.

Erosion of roadbanks, ditches, and unpaved roads is not a severe problem but is a potential hazard if establishment and maintenance of vegetation are not carefully accomplished. Minor critical areas exist in the watershed, but most of the areas are in the process of stabilization. These areas need only a continuation of present practices to become stabilized.

Flood plain erosion is not critical, though it is a problem. Minor scour channels exist on the flood plain throughout the watershed. Scour damage consists of (1) loss of productivity by removal of fertile top soil and (2) damage to plants caused by water standing in the scour channels. This condition tends to discourage desirable plants and increase the difficulty of agricultural operation. Scour has damaged 3,335 acres of the flood plain, reducing the productivity of the land by 5 to 17 percent.

Streambank erosion occurs in the watershed but is not considered a serious problem or a major source of sediment.

Erosion damage in the form of scour is estimated to be $8,713 each year.

Problems Relating to Water Management

Drainage - Necessary drainage in this watershed can be accomplished with farm drainage systems with adequate outlets.

Irrigation - Approximately 150 acres are being irrigated in the watershed. Irrigation water comes from reservoirs and Cypress Creek which will supply water for anticipated needs.

Municipal and Industrial Water - Cypress Creek is the source of water for the City of Florence. The water supply for the rural-residential developments also come from this creek. The proposed watershed development is not expected to interfere with the water source for Florence and the rural-residential developments.

Recreation - There is a limited number of public recreational developments within driving distance of the watershed. Florence State University which has 4,000 students and 250 faculty and staff members, needs water-based recreational facilities. The University expects to have 10,000 students by 1980.

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Fish and Wildlife - Fish and wildlife resources within the watershed have little management. The quality and quantity of food, cover, and water for game and fur-bearing species need improvement.

Floodwaters from Little Cypress Creek damaged busy Cloverdale Road (Highway 157) resulting in costly repairs and lengthy re-routing of traffic. Flood damages such as this endanger life and property, use road funds needed for other purposes, and result in time-wasting disruption of traffic flow.

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Flooding from Cox and Cypress Creeks severely damaged the tractor (foreground) and the soybean field (covered with floodwater) at rear. These costly damages are a loss to the entire community.

High water mark on a farm building near Cypress Creek. Flooding costs thousands of dollars each year in damages to buildings, foundations, equipment and supplies along Cypress Creek and its tributaries.

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Roads and pastureland covered by floodwater from Cypress Creek. Flood damages shown include traffic delays, loss of livestock and destruction of crops, pastures, and fences.

Receding floodwater reveals desolation after a spring flood on Cypress Creek. Removal of sediment and debris from roads, fences and farmland costs the landowners and the community thousands of dollars each year.

Swiftly moving floodwater from Cypress Creek spread gravel on this field. Unless this infertile sediment is removed, at a large cost, the land will remain unproductive for many years.

PROJECTS OF OTHER AGENCIES

Cypress Creek Watershed is located in the Tennessee River Basin, which is serviced by the Corps of Engineers, Nashville District, and the Tennessee Valley Authority. The Tennessee Valley Authority owns about 575 acres in the lower reaches of Cypress Creek Watershed bordering Pickwick Reservoir. The City of Florence is presently developing a recreational area on a portion of these lands. With the completed recreational area, the land will be adequately treated and no additional land treatment measures will be needed to meet project objectives. Pickwick Reservoir is owned, operated and maintained by the Tennessee Valley Authority.

The U. S. Department of Interior, National Park Service, owns and manages the Natchez Trace Parkway, which crosses the western portion of the watershed. The parkway is operated as a scenic route from Natchez, Mississippi, to Nashville, Tennessee. National Park Service lands are excellently managed and no additional land treatment is needed.

BASIS FOR PROJECT FORMULATION

The local sponsoring organizations outlined the following objectives: (1) to reduce erosion and runoff on the uplands by accelerating the rate of application of needed land treatment measures, (2) to provide approximately a 75 to 80 percent reduction in floodwater damages, (3) to improve the present fish and wildlife resources where feasible, (4) to provide beneficial

water storage for recreational and instructional use by Florence State University, and (5) make more efficient use of all human and physical resources in the total economic development of the watershed and surrounding area. The Soil Conservation Service is in agreement with the objectives as established by the local sponsors.

Land treatment measures are the basic element in formulating a watershed project and are essential if it is to function successfully. Land treatment measures included in this plan were selected on the basis that they will (1) be effective in reducing erosion damage on existing cropland; (2) reduce runoff and sediment production that would adversely affect operation, maintenance, and the useful life of the proposed works of improvement; (3) be necessary to assure full realization of project benefits; and (4) increase the efficiency of land use on all farms.

The forest land treatment program was developed from a field survey of the watershed and is based on needs over that supplied by the going programs.

The average percent burn from 1961 through 1966 of forest lands of the watershed in Wayne County, Tennessee, was .076 percent. The average percent burn of the forested area of the watershed in Lauderdale County, Alabama, was 1.31 percent. The allowable burn goal for the states of Alabama and Tennessee is 0.25 percent. Lauderdale County, Alabama, and Wayne County, Tennessee, are under fire protection. Additional fire equipment will be assigned to Lauderdale County, Alabama. Wayne County, Tennessee has already assigned additional equipment to the area.

To alleviate the floodwater damage problems, first consideration was given to using floodwater retarding structures. Channel improvement was considered as a supplement to floodwater retarding structures to attain project objectives.

A study of the watershed was made to locate all possible floodwater retarding structure sites. Twenty-two sites were located. Three of these sites were eliminated because of permanent improvements that could not be economically relocated. Several different combinations of floodwater retarding structures were studied. Nineteen floodwater retarding structures supplemented by approximately 50.3 miles of channel improvement will be required to meet project objectives.

Several of the floodwater retarding structures were considered for storing beneficial water for recreational and instructional uses by Florence State University. Site No. 9 was selected to serve this purpose. Florence State University is a state-supported institution with an enrollment of about 4,000 and 250 staff members. The University, one of the local sponsoring organizations, will pay all costs allocated to recreation. The local sponsoring organizations determined that there was not sufficient interest to develop a public recreation enterprise.

It is recognized that channel improvement will damage some of the existing fish and wildlife habitat. Appropriate mitigation measures are included in the planned structural measures.

Indian sites in the channel improvement area will receive close archaeological supervision provided by the University of Alabama Museum of Natural History.

A detailed study was made of Cox Creek lateral to determine the feasibility of providing urban protection. From this study the sponsors decided that the proposed floodwater retarding structure and channel improvement would not be included in the plan because of a conflict with other fixed improvements.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Land treatment is considered the basic element in formulating the watershed program. Technical assistance will be made available to landowners to apply needed land treatment measures. The prime objective of the program is to use each acre of land within its capability and treat it according to its needs. Land treatment measures will be planned and applied under an accelerated program of Soil and Water Conservation Districts.

Measures will be planned and applied to hold soil loss at the minimum level as reflected in work unit technical guides. Landowners will be encouraged to convert land that is presently being used beyond its capability to uses within its capability. Terraces, field borders, diversions, vegetative waterways, and other conservation practices will be installed to control runoff, reduce erosion, and provide adequate water disposal systems for the upland. Surface ditches and stream channel improvement will be installed to provide an efficient means of controlling erosion and removing runoff from the upland and small tributaries.

Interested landowners will be encouraged to install land treatment measures that will improve habitat for fish, forest game (deer, squirrel, and turkey) waterfowl, and farm game (quail, dove, and rabbit) for income-producing recreation or for home-use hunting and fishing. Ponds for public fishing have excellent potential as income-producing measures. These land treatment measures will help offset damage to fish and wildlife habitat caused by structural works of improvement.

Technical assistance will be provided in the selection of sites, design of structures, and fishpond stocking and management. State, federal, and private fish hatcheries will be requested to stock ponds according to standards and specifications of work unit technical guides.

The land treatment measures on forest land will reduce runoff and prevent erosion by stabilizing the soil. Forest litter produced under proper forest management and protection is the source of a good humus layer needed to increase infiltration rates and water storage capacity. If desirable humus building species are favored during cutting operations, this will assure the development of well aggregated soils and the maintenance of a good humus layer.

A forest management program aimed at fulfilling watershed needs and objectives will be followed. The forest lands will be managed to fulfill timber, wildlife and recreation needs to the extent that such management is compatible with sound watershed management. The aim will be to maintain

hardwood on hardwood sites and to encourage pine-hardwood mixtures on pine lands. A balance will be maintained between food-bearing and den trees, and potential timber trees.

Where fire equipment is purchased for assignment to the Alabama portion of the watershed, it will consist of a pickup truck and a slip-on tanker unit. No equipment will be purchased for the Tennessee portion. The Tennessee Division of Forestry assigned an additional unit of fire control equipment to the watershed in 1967. They feel that this equipment will help to reduce the percent burn figure on that part of the watershed to an acceptable level.

The following program has been developed from a statement of land treatment needs prepared by the Alabama Forestry Commission, Tennessee Division of Forestry, and the U. S. Forest Service after a field survey of the watershed and from land use recommendations by the Soil Conservation Service.

The land treatment measures are:

Watershed Protection

(1) Tree Planting - Non-critical Area (2,000 acres)

Reforestation of appropriate open land and understocked stands is necessary to adjust land use capability. This will reduce runoff and erosion by developing a protective cover and an absorbent forest floor of a spongy humus layer under a protective layer of litter.

(2) Stand Improvement Measures (3,700 acres)

These operations are aimed at improving hydrologic conditions by manipulation of stand composition to create favorable conditions for the maximum production and protection of litter, humus, and forest cover. They include the removal of inferior species and cull trees; release, improvement, and harvest cuttings.

Structural Measures

Eighteen floodwater retarding structures and one multiple-purpose structure will be installed at locations shown on the project map. Structures at these locations control 50 percent of the drainage area above the confluence of Cox Creek Lateral and Cypress Creek. All nineteen structures are planned to be constructed on yielding foundations with foundation drains in each structure.

Principal spillways of structures no. 9, 13, 18, 19, 20, and 21 will have single-stage inlets. The remaining thirteen structures will have two-stage inlets. Both type inlets are planned to outlet into excavated stilling basins. All principal spillway designs are based on the 50-year, 24-hour and 50-year, 10-day precipitation except site no. 20. Runoff curve numbers were determined by averaging the curve number for an antecedent moisture condition of II and the curve number for an antecedent moisture condition of III.

All the emergency spillways except site no. 20 are designed to permit passage of the runoff from a 16.5 inch, 6-hour rainfall using an antecedent moisture condition of II½. The material in the emergency spillways consists of ML's, SM's and GM's. Excavated materials in emergency spillways plus similar materials in adjacent areas will provide the fill material for the floodwater retarding structures.

Structure no. 20 is classified according to SCS Engineering Memorandum 27 as a class "c" structure. The total drainage area above structure no. 20 is 31.33 square miles with 12.30 square miles controlled by upstream structures. The principal spillway on site no. 20 was designed using the runoff from a 100-year 24-hour and 100-year 10-day precipitation with an antecedent moisture condition of II½ on uncontrolled drainage areas plus outflow from upstream structures. The emergency spillway was designed using the runoff from an emergency and freeboard hydrograph based on total drainage area with an antecedent moisture condition of II and upstream structures in place. Adjustments were made for drainage area and storm duration.

Reservoir capacity provides for the 100-year sediment accumulation; however, initial water storage will only be to the 50-year sediment capacity level in all reservoirs except site no. 9. Site no. 9, a multiple purpose reservoir, provides water storage for the 100-year sediment plus 280 acre-feet of water for recreation. The beneficial water storage will have a surface area of 72 acres with a maximum depth of 19.3 feet. A drainage area of 5.98 square miles will provide sufficient inflow to maintain the water level while a single-stage inlet will provide a reduced water line fluctuation.

Sponsors have accepted the responsibility for installing necessary sanitary facilities adjacent to the floodwater retarding structures to meet local and state health regulations.

A water level control device will be installed in structure nos. 6, 10, 15, 16, 17, 18, and 19 to permit seasonal variation (2 to 4 feet) of the water levels to mitigate the damages that will occur to waterfowl habitat in the stream channels and flood plains (as a result of the flood control measures). To mitigate stream fishery loss, a cool water inlet will be installed in structure nos. 11 and 21 to reduce increase in stream temperatures caused by structural measures.

There are no depressions in the flood pool reservoir areas that will retain water following flooding. Installation of the structures will require the following. Raising or re-routing of county roads located in the flood pool of structure nos. 9, 11, 13 and 20. Raising or relocating utility lines on structure nos. 9, 11, 12, 13, 16, and 20. Removal of abandoned houses, barns or sheds on structure nos. 13, 16, 20 and 21. Structure no. 9 has an occupied house that will be removed from the recreational development area.

Approximately 50.3 miles of channels will be improved at locations shown on the project map. Cypress Creek channel from Station 1247+00 (confluence Little Cypress Creek) to Station 965+00 (confluence Burcham Creek) is designed to accomodate the peak flow produced by a 0.7 year frequency 24-hour duration storm. All other channels to be improved are designed

to accomodate the peak flow produced by a 0.8 year frequency 24-hour duration storm.

Natural stream gradients in this watershed are considerably higher than ordinary with grades ranging from 0.0011 to 0.0065. Proposed channel designs utilize these gradients by setting the hydraulic gradient to run parallel to the general ground line. The proposed channels are designed for depths that follow the bottom of existing channels without excessive cuts into the bed of gravel and rock ledges. In general, the design depths range from 3.4 to 8.0 feet; widths range from 4 feet to 108 feet. The relatively wide and shallow channel proportions are an attempt to hold velocities as low as possible in order to protect the bank soils, but high enough to keep the bedload of coarse gravel and cobbles from aggrading the channel (See Investigations and Analyses--Channels; Watershed Problems--Sediment Damages).

Where feasible, planned channels are located and proportioned to utilize the existing channels. If possible, floating dredges and/or stationary sand pumps will be used to accomplish the necessary excavation in reaches where retention of the vegetative cover along the banks of the existing channel is important. Where this method of construction is not practical, excavation will be accomplished with conventional earth-moving equipment such as draglines or scrapers. Excavation with this equipment will be limited to one side of the channel where practical. Alignment will be improved and stability maintained or improved by excavation on the inside of bends. Excavation will be limited to the east side of the main where the National Park Service owns or has scenic easement. Natural vegetation and undisturbed soil will be preserved on the outside bank in bends wherever possible. Rock rip-rap or equivalent protection will be placed on channel side slopes where curvature exceeds five degrees.

The spoil will be shaped to permit safe mowing or other maintenance practices. Provisions for surface drainage will be made by open ditches or rock flumes, pipes through the spoil bank. Pipe will be used only where scour will be a problem or travel-way require such. Travel-ways will be provided to all channels during construction. Where the travel-way crosses old channels and tributaries, pipes or fords will be installed.

In order to prevent washing of spoil and bank soil onto the flood plain and to reduce construction-induced sediment pollution, the following measures are planned: (1) appropriate vegetation will be planted on the berms, spoil areas, and upper part of the banks and other disturbed areas after excavation is completed; (2) the channel will be inspected during the first year and revegetation or reinforcing vegetation planted in key spots such as on curves and at bridges. These two measures are now standard procedure on channel jobs in Alabama. Minor soil losses from the upper channel banks are expected if large rains occur during the first few months following construction. This loss is not expected to be significant since only the upper one-third of the slope is silty, easily erodible material. The lower two-thirds being large gravel and cobbles are not easily eroded. The sponsors have been advised that a high degree of maintenance on their part may be required during the first two years following construction (See Provisions for Operation and Maintenance).

Degradation is not expected to be a problem. Natural gradient control is present in the form of rock shoals and heavy cobble bars. The bed materials are expected to be stable at velocities ranging from 5.50 to 8.25 feet per second; design velocities in all reaches are below these limits, (See Table 3A and Investigations and Analyses). Reaches having the highest velocities are those which have their gradient controlled by rock so that reducing the grade is not feasible (See Table 3A).

One additional factor should be noted in relation to gradient control by channel bed materials. The channel banks will not be subjected to the stresses of oversteepening caused by degradation and bank sloughing to reach equilibrium.

Short stretches of channel improvements in the watershed such as at road crossings and privately financed channel jobs all show good stability even though high velocities exist. One measurement of base flow showed a velocity of 4.5 feet per second at 18 inches depth of flow. This compares with 5.07 feet per second velocity and 7.8 feet depth in the designed channel for this reach. Comparison of the planned Cypress Creek channels to similar channels appears in the section on Investigations and Analyses.

To mitigate stream fishery losses, deflectors will be placed in three sections of the planned channel improvement. The location where these deflectors are to be placed will be determined jointly by the sponsors, personnel from the Alabama Department of Conservation, Bureau of Sport Fisheries and Wildlife, and Soil Conservation Service. Five deflectors will be placed in each of three sections of channel.

The present land cover of the sediment pools, fill and emergency spillway areas of the floodwater retarding sites range from 35 to 95 percent cropland or pasture. The construction area of the channel improvement is mainly in pasture or cropland with narrow hedge rows and trees along the channel banks.

In acquiring land rights two farming operations, one business, and five dwellings will be displaced. Site 2 will require the displacement of an owner-occupied trailer, which will displace three persons. The trailer is located on an 80 acre farm. Site 3 involves the displacement of one person in a tenant occupied home. The house is a small frame structure with no bath and no running water located on a 1120 acre farm. Site 6 will require the displacement of a cabinet shop business. The cabinet shop is located on a farm. Site 9 will displace two people from an owner-occupied home. The home is a weather boarded two-story structure with one bath. Installation of site 13 will cause the displacement of a hog operation. The displaced facilities include a lagoon, holding pen, farming stalls, and one feed out barn. One person in a tenant-occupied home will be displaced on Site 16. The facility is a small frame house with one bath. The house will have to be moved a few feet up the hill to escape the water in Site 16, and will not require a new road for gaining access to the house. Site 20 will cause the displacement of 5 persons in an owner occupied frame house with one bath. The house is located on a 3 acre tract of land. The installation of Site 21 will displace a catfish farming operation. Involved is 5 surface acres of water and a rainbow trout raceway.

EXPLANATION OF INSTALLATION COSTS

Land Treatment

All costs of land treatment measures, except technical assistance, will be borne by the landowners and operators with such assistance as may be available under other going programs.

Public Law 566 funds will provide $81,000 to accelerate technical assistance to private landowners in this watershed. Technical assistance for installing forestry measures will be $16,000 and $65,000 will be used for making conservation farm plans, soil surveys, and applying land treatment measures. The Soil Conservation Service will also provide an estimated $32,500 in technical assistance under the going program.

The estimated cost of the forest land treatment program is $264,300. Of this amount $18,000 will be provided under authority of P. L. 566, and $246,300 will be contributed by other sources. The estimated cost of other land treatment is $1,193,000. Of this amount $65,000 will be provided from P. L. 566 funds and $1,128,000 will be financed by other sources. The P. L. 566 funds for forest lands include $16,000 for accelerated technical assistance, ($10,000 in Lauderdale County, Alabama, and $6,000 in Wayne County, Tennessee). The Cooperative Forest Management Program will provide technical assistance valued at $8,600 ($5,400 through the Alabama Forestry Commission, and $3,200 through the Tennessee Division of Forestry). The Cooperative Forest Fire Control Program will provide $53,600, ($19,300 through the Alabama Forestry Commission and $34,300 through the Tennessee Division of Forestry). The States, through capital outlay acceleration, will provide $25,600 ($16,200 through the Alabama Forestry Commission and $9,400 through the Tennessee Division of Forestry) during the life of the project. P. L. 566 funds will provide $2,000 for additional fire equipment to be assigned to Lauderdale County, Alabama. The Alabama Forestry Commission will provide $2,000 for this fire equipment.

The landowners and operators will finance the $147,900 for installation of the measures ($93,200 by Alabama landowners, $54,700 by Tennessee landowners). It is expected that financial assistance will be available through the Agricultural Conservation Program.

The total estimated cost of all land treatment measures is $1,457,300 (Table 1). The P. L. 566 share of this cost will be $83,000 or 5 percent, and the Other cost will be $1,374,300 or 95 percent.

It is estimated that funds for land traatment measures will be obligated by years as follows:

	P. L. 566	Other
First	8,000	127,800
Second	8,000	127,800
Third	8,000	127,800
Fourth	8,000	127,800
Fifth	8,000	127,800

	P. L. 566	Other
Sixth	8,000	127,800
Seventh	8,000	127,800
Eighth	8,000	127,800
Ninth	8,000	176,800
Tenth	9,000	175,100
TOTAL	$83,000	$1,374,300

Structural Measures

Nineteen floodwater retarding structures (one multiple-purpose) and approximately 50.3 miles of channel improvement will be installed at a cost of $6,433,389 of which $5,351,311 is P. L. 566 funds and $1,082,078 are Other Funds.

P. L. 566 funds include $2,668,699 for construction of floodwater retarding structures, $223,620 for construction of the multiple-purpose structure, and $1,289,953 for construction of channel improvement. The estimated construction cost includes $8,000 for water level control gates in eight structures, $700 for cool water inlets in two structures, and $30,000 for 15 deflectors to be installed in the channel to mitigate damages to fish and wildlife resources.

The construction cost for structural measures includes the estimated cost of all materials and labor necessary for the installation of the measures. The unit price assigned each quantity is based on local prevailing prices (1970) and previously constructed projects. A contingency of 12 percent was added to cover unforseen items of cost during construction.

Use of Facilities Method was used to allocate cost to purposes in Multiple-purpose Structure No. 9. The estimated construction cost is $257,627 of which P. L. 566 funds will bear $223,620 (86.8 percent flood prevention) and Florence State University will bear $34,007 (13.2 percent recreational use). The percentages used to allocate cost to purposes will be used to allocate actual cost to P. L. 566 funds and Other funds. The estimated engineering services cost for Structure No. 9 is $20,610 of which $17,889 will be borne by P. L. 566 funds and $2,721 will be borne by Florence State University.

The cost of relocation payments is estimated to be $23,000 of which all will be borne by P. L. 566 funds if relocation payments are made before July 1, 1972. For P. L. 566 funds to pay the first $25,000 cost acquisition of land rights for the relocations involved must be acquired before July 1, 1972. A description of the relocation payments is included under the "Works of Improvement to be Installed" section. Cost sharing percentages for relocation payments shown in the work plan agreement are based on the ratio of P. L. 566 funds and other funds to total project costs. The Service will provide the first $25,000 for each displacement occurring prior to July 1, 1972.

The cost of engineering services is estimated to be $365,274 of which $362,553 will be borne by P. L. 566 and $2,721 will be borne by Other funds. Engineering Services include the direct cost of engineers and other tech-

nicians for surveys, investigations, design and preparation of plans and specifications for structural measures including the vegetative work.

Other funds for land rights are estimated to be $1,031,050. Included in the land rights costs are $33,500 for road and bridge alterations and $37,500 for relocation of fixed improvements.

The Cypress Creek Watershed Conservancy District will be responsible for the relocation advisory services for the Alabama portion of the Relocation Assistance and Real Property Acquisition Policies Act of 1970. They will bear the cost incurred in serving notice of displacement, providing appropriate application forms, assisting in filing applications, hearing and resolving grievances, and in making relocation payments. The Three Cypress Creek Watershed District will be responsible for all of the above cost incurred in connection with any relocation payments involved in Tennessee. The Soil Conservation Service will bear only the costs involved in assisting the Cypress Creek Conservancy District and Three Cypress Creek Watershed District in providing relocation assistance advisory services.

Project administration cost includes the cost of contract administration and inspection services during construction. Project administration is estimated to be $797,586, of which $783,286 will be borne by P. L. 566 funds and $14,300 by Other funds. The Other fund is the cost for administering the contracts, which includes cost of legal services, advertising for bids, and other administrative costs in handling contracts.

Included in local project administration cost is relocation assistance advisory services which will be incurred by the Cypress Creek Watershed Conservancy District and the Three Cypress Creek Watershed District at an estimated cost of $800. This cost will not be cost shared, but will be incurred totally by the above sponsors.

It is estimated that funds for structural measures will be obligated by years as follows:

Year	P. L. 566	Other
First	400,200	100,500
Second	618,700	132,100
Third	885,300	186,000
Fourth	286,800	15,378
Fifth	490,400	26,500
Sixth	355,000	20,000
Seventh	780,000	73,500
Eighth	430,000	141,000
Ninth	595,000	50,100
Tenth	509,911	137,000
TOTAL	$5,351,811	$1,082,078

EFFECTS OF WORKS OF IMPROVEMENT

The project will enhance the general economic conditions of the area by reducing flood damages, providing job opportunities, increasing net income, and encouraging more efficient utilization of available resources.

The area benefited by structural measures is 12,456 acres. Benefits were evaluated on the area that is inundated by the 100-year frequency flood. Approximately 320 landowners have land in the flood plain that will be benefited. The entire farming operation is enhanced when any part of the farm is benefited, yet benefits were evaluated only on the flood plain. The farming operation is benefited by a more efficient use of resources.

Planned project measures will decrease the frequency of flooding significantly. Damages will be reduced by 80 percent. Channels will carry in bank the peak flow produced by the 0.8-year frequency 24-hour duration storm. Areas flooded with and without the project for selected storms are as follows:

Frequency	Acres Flooded Without Project	Acres Flooded With Project
1-year	5,912	1,301
2-year	7,640	3,540
10-year	9,512	6,782
100-year	12,456	8,759

The peak discharge produced by all storms was decreased. The discharges on the main immediately above the confluence with Middle Cypress are:

Frequency	Peak Discharge Without Project	Peak Discharge With Project
10-year	7,717	5,306
100-year	14,134	8,239

Peak discharges on the main immediately above confluence with Little Cypress are:

Frequency	Peak Discharge Without Project	Peak Discharge With Project
10-year	16,672	14,113
100-year	31,301	22,294

Peak discharges on the main just above its confluence with Cox Creek are:

Frequency	Peak Discharge Without Project	Peak Discharge With Project
10-year	22,041	15,936
100-year	37,182	25,055

Peak discharges on Middle Cypress at Highway 157 are:

Frequency	Peak Discharge Without Project	Peak Discharge With Project
10-year	6,631	4,277
100-year	11,738	6,639

Benefits derived from the reduction of the flood hazard will improve economic conditions in the watershed. These benefits are primarily in the form of reduced flood damage to crops and pasture, fixed improvements, and public roads and bridges. Some of the farms with gross sales of less than $2,500 annually will increase their output and provide for higher standards of living. More efficient use of resources will result in reduced costs per unit of output.

A considerable financial outlay will result from the installation and operation of the planned structural measures. It is estimated that about 150 man-years of local employment will result from the installation of the measures during the 10 year installation period.

The combined effect of the proposed land treatment and floodwater retarding structures will reduce the amount of sediment deposited in Cypress Creek channel and Pickwick Reservoir on the Tennessee River. Land treatment measures will reduce the sheet erosion, and floodwater retarding structures will provide for approximately 5,760 acre-feet of sediment storage. Benefits from the reduction in sediment were not claimed.

The reduction in flood hazard will allow landowners to utilize resources more efficiently. More intensive use of existing cropland will be realized on 7,737 acres. Five hundred and sixty-three acres of poor woodland will have a changed land use to improved pasture. Presently there are 188 acres of unused land that were previously in agricultural production and have been abandoned because of the flood hazard. This land will be restored to its former productivity with the project.

Local secondary benefits will accrue in the watershed and surrounding area as a result of the project. The increase in agricultural production will result in a greater demand for agricultural machinery, equipment, and supplies. The additional income of the landowners will have a multiplier effect in the area. Increased profits by local industries will increase the demand for transportation, processing, and marketing of the increased production.

Florence State University plans to fully develop the area surrounding the multiple-purpose structure. The University plans to use the development for both recreation and instruction. A portion of the area will be developed with cabins for use by the faculty and staff. Students will use the reservoir for fishing, boating, swimming, picknicking, and camping. The development will be used for instruction in conservation, biology, and physical education. It is anticipated that the development will have 51,280 user-days each year. The value of each user-day was estimated to be $1.50.

Incidental recreational use by local residents will be made available by the reservoirs of floodwater retarding structures. All single-purpose floodwater retarding structures will be available to the public or organized groups for recreational use. The main attractions of the reservoirs will be fishing, picnicking, and sight-seeing. Sanitary facilities will be installed to meet state health department regulations. A study was made by the health officer in Lauderdale County to determine water quality in the watershed. This study showed the water to be of acceptable quality for the intended recreation uses.

Rural-residential developments are presently being developed surrounding two of the planned structure sites. Because floodwater retarding structures have desirable reservoirs, the value of land surrounding the two structures will be enhanced. A public water supply is available to these developments. These developments were in progress when the proposed structures were planned and all enhanced land values are incidental to the project.

Application of the planned forest land treatment and management measures will reduce erosion, runoff and sediment problems. Well-managed forests will enhance recreation, wildlife habitat, timber production values and water quality.

Urban development drainage problems in the forested part of the watershed, can be alleviated through the coordinated effort of the watershed forester, planning commissions, land developers or comparable organizations.

The forest and wildlife resources will be benefited by a more efficient use of forest and wildlife habitat management techniques to enhance the value of forest products and availability of wildlife food in the area.

Tree planting on 2,000 acres of relatively unproductive land will be brought back into production and in turn enhance the economy of the watershed area.

The project will have definite benefits to fish and wildlife. More ponds will be built, stocked, and managed for fish production. There will be less silt in streams. This reduction in silt will have long-time benefits to stream fishery, especially in the lower reaches.

Channel improvement will have short term detrimental effects to stream fishery. Some wildlife habitat will be temporarily disturbed. The planned mitigation measures will decrease the amount of damage to stream fishery.

Although not designed specifically for fish production, the floodwater retarding reservoirs will provide some fish habitat; and fishing will be increased. The impoundments will be especially attractive to migrating waterfowl and may provide habitat for winter.

Wildlife practices installed in the accelerated land treatment program will provide more wildlife habitat.

Reduced flooding will result in greater nesting success for ground-nesting birds, especially quail, wild turkeys, and some of the non-game birds. Fire protection will also benefit wildlife.

The relocations will affect the environment by causing five houses to be moved or raised to new locations. In general the conditions of the new housing for displaced persons will be comparable or better than the present housing, thereby improving the environment for these displaced persons. The environment will be affected by covering in water a five acre catfish pond and one rainbow trout raceway. Installation of Site 13 will involve moving one hog operation to a new location. This will mean that new land will be covered by the holding pens and feeding barns which will be constructed at a new location.

PROJECT BENEFITS

Average annual damage reduction benefits to crops and pasture are $177,345, which includes $8,932 of restoration to former productivity.

Other agricultural damage reduction benefits; minor fixed improvements such as fences, water gaps, farm roads, and bridges; and farm drainage systems amount to $23,494 annually.

Benefits from the reduction in damage to public roads and bridges are $12,882 annually. Average annual damage reduction benefits from flood plain scour amount to $5,605.

Average annual damage reduction benefits to structural measures amount to $210,509 and represent an 80-percent reduction in flood damages. In addition, another $9,460 will be realized from land treatment. Indirect benefits are $19,258 annually.

Benefits from more intensive use of cropland amount to $111,153 annually on approximately 7,737 acres. These were calculated on the basis that landowners will make more efficient use of available resources with the project. The project will enable landowners to plant and harvest crops at the proper time. Better quality crops will be produced. Changed land use benefits were calculated to be $26,795 annually. It is not expected that there will be any increase in the production of surplus crops.

Redevelopment benefits resulting from the installation and operation of the structural measures are $73,547. These benefits result from the employment of local labor during installation and operation. It is estimated that 150 man-years of employment will be created by the construction of the project measures. Benefits from the planned recreation in the multiple-purpose structure are $63,920 annually. The benefits were based on user-days for both recreation and instruction. Benefits from the enhanced land values surrounding the recreational development were not evaluated. 1/

The average annual benefits resulting from the enhanced land values surrounding the two reservoirs in the residential areas are $39,237. These benefits are incidental and will accrue to a number of beneficiaries.

1/ Costs of basic facilities for recreation and instruction associated with the development are estimated to be $252,000. This cost was treated as an associated cost and deducted from gross benefits.

Incidental recreation in the form of fishing, boating, and picnicking will be realized from the floodwater retarding structures. The reservoirs will generally be open to use by the public and organized groups. Average annual benefits from incidental recreation are $13,538. They are based on the expected number of visitor-days to the reservoir.

Secondary benefits averaging $55,549 annually will result from increased income to wholesalers, processors, and suppliers in the immediate trade area. They occur as a result of increased net income to producers and processors of farm products and to suppliers of farm equipment and materials required to achieve the increased agricultural production made possible by the project. Secondary benefits from the national standpoint were not pertinent to the economic evaluation of this watershed.

COMPARISON OF BENEFITS AND COSTS

The average annual benefits without local secondary benefits amount to $538,700. The average cost will be $383,125, therefore, the benefit-cost ratio without local secondary benefits will be 1.4:1.

The total average annual benefits accruing to structural measures amount to $594,249; and the average annual cost will be $383,125, with a benefit-cost ratio of 1.6:1 (Table 6).

PROJECT INSTALLATION

Land treatment measures on private land will be established within the 10-year installation period by individual farmers in cooperation with the County Soil and Water Conservation Districts. The Districts will provide technical assistance for the planning and application of the project measures. Landowners will receive financial assistance through the Rural Environmental Assistance Program in installing land treatment measures. The Soil Conservation Service, using P. L. 566 funds, will supplement the assistance provided under the going district program. This additional technical assistance will accelerate the rate of planning and application of the land treatment measures.

Forest landowners will be encouraged to apply and maintain the best forestry measures on their woodlands.

The Alabama Forestry Commission and the Tennessee Division of Forestry in cooperation with the U. S. Forest Service, will provide technical assistance in the planning and application of forest land treatment measures. Technical assistance will also be provided to assist the landowners and operators in any special problems generated by urban development in the forested areas. They will provide additional technical assistance for accelerating the installation of the planned land treatment measures. The foresters assigned to this project will be trained in watershed management. They will assist and guide the landowners in the installation of the planned forestry measures. One of the first objectives of the foresters will be the

preparation of watershed management plans on the woodlands as a part of the Conservation Farm Plans.

The Cypress Creek Watershed Conservancy District, organized under Alabama statutes, will acquire all necessary land rights for the installation of the structural measures in Alabama. The Lauderdale County Commissioners Court will install structural measures in Alabama by contract during the 10-year installation period. The Three Cypress Creek Watershed District, organized under Tennessee statutes, will acquire a necessary land rights and contract for structural measures in Tennessee. All powers granted by the state will be used, if necessary, to achieve project objectives. This includes the power of eminent domain. The directors have contacted the owners of the property upon which works of improvement are to be installed. Most have agreed that an amicable settlement can be reached. Special use permits will be obtained from the National Park Service before any work is performed on parkway lands. All necessary land rights will be acquired for approximately two years of design and construction work before P. L. 566 funds are made available.

As a part of project administration the Cypress Creek Watershed Conservancy District and Three Cypress Creek Watershed District will provide written notice of displacement and appropriate application forms to each displaced person, business or farm operation, assist in filing applications, review and approve applications for relocation assistance, review and process grievances in connection with displacements, and made relocation payments. The Soil Conservation Service as a part of its project administration responsibility will assist the Cypress Creek Watershed Conservancy District and Three Cypress Creek Watershed District in fulfilling their responsibilities. The Cypress Creek Watershed Conservancy District and Three Cypress Creek Watershed District, as a part of project administration will provide such relocation assistance advisory services as may be needed in connection with the relocation of displaced persons, businesses or farm operations.

The sponsors have determined that decent, safe, and sanitary replacement housing will be available for all persons subject to displacement by the project. These persons will be given at least a 90 days notice before they have to move.

The Soil Conservation Service will prepare plans, specifications, and cost estimates; provide construction inspection; and cooperate in the final inspection. The National Park Service will be provided plans for review and comment before giving their approval of any work on parkway lands.

Florence State University will install all basic facilities as associated measures adjacent. The development will be installed and operated in accordance with state and local health regulations.

The following installation sequence is recommended. Construct dam numbers 9, 11, 13, 15, 17, 19, and 21 without any channel improvement. Follow these dams with channel improvement on Cypress Creek Main from station 357+00 to station 1247+00 Threet Creek, North Fork, and Dulin Branch laterals. Follow this channel improvement with structures number 1, 2, 3, 5, 6, 7, and 8. The next installation should be channel improvement on Bruton Branch,

Burcham Branch, Latham Branch, Little Cypress Creek, and Chisholm Branch. Construct dams number 10, 12, 16, 18, and 20 last.

FINANCING PROJECT INSTALLATION

The federal government, under authority of the Watershed Protection and Flood Prevention Act (P. L. 566 as amended), will provide financial and technical assistance in carrying out the project works of improvement. The sponsors, using other authorities and private funds, will provide their share of the cost for installation of the planned works of improvement. A letter of intent to finance their share of the project by utilizing loan provisions of section 8 of P. L. 566 has been filed with Farmers Home Administration. The loan will be repaid through an annual assessment. Availability of financial and other assistance to be furnished by the Soil Conservation Service under Public Law 566 and other authority is contingent on appropriation of funds for this purpose.

Landowners cooperating with the County Soil and Water Conservation Districts will install the land treatment measures. Cost-sharing may be available under the Rural Environmental Assistance Program to assist in applying these measures.

The costs other than P. L. 566 in the application of forest land treatment measures will be provided by the landowners and operators. The Rural Environmental Assistance Program is expected to cost share with qualified landowners in the installation of these measures.

The Lauderdale County Commission will provide the contracting services and install the structural measures in Alabama. The Three Cypress Creek Watershed District will contract for installation of structural measures in Tennessee. The Cypress Creek Watershed Conservancy District and the Three Cypress Creek Watershed District will provide the land rights for structural measures. Florence State University will finance all cost allocated to the storage of recreation water in Site No. 9. The University will pay all cost of installing basic facilities adjacent to Site No. 9. Cost allocated to recreation is not eligible for any assistance under Public Law 566.

The cost of relocation payments not including land rights will be provided by P. L. 566 funds if relocation payments are made before July 1, 1972. Relocation assistance advisory services cost will be incurred by the Cypress Creek Watershed Conservancy District and Three Cypress Creek Watershed District, as a part of project administration. This financing will come from private funds. The Cypress Creek Watershed Conservancy District will be responsible for advisory services in the Alabama portion of the watershed and Three Cypress Creek Watershed District will be responsible for the cost of the Tennessee portion of the watershed. Assistance to the above sponsors will be provided by the Soil Conservation Service as a part of project administration cost.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be operated and maintained by landowners

under cooperative agreements with Soil and Water Conservation Districts. The Soil Conservation Service will provide necessary technical assistance through the district for operation and maintenance of land treatment measures.

The forest land treatment measures will be maintained by the landowners and operators under agreement with the Lauderdale County, Alabama, Soil Conservation District, and Wayne County, Tennessee, Soil Conservation District. The Alabama Forestry Commission and the Tennessee Division of Forestry, in cooperation with the U. S. Forest Service, will furnish technical assistance necessary for operating and maintaining the forest land treatment measures under the going Cooperative Forest Management Program. The Alabama Forestry Commission and the Tennessee Division of Forestry will continue to furnish fire protection under the Cooperative Forest Fire Control Program. The cost of operating and maintaining the proposed structural measures is estimated at $35,466 annually. The Lauderdale County Commission will be responsible for single-purpose floodwater retarding structures no. 8, 11, 12, 13, 15, 16, 17, 20 and 21 and the channel improvement. These services consist of labor, material, and funds which amount to $18,462 annually. Florence State University will operate and maintain structure no. 9, the multiple-purpose structure, and basic facilities installed adjacent to this structure. The estimated operation and maintenance cost for this development is $14,358 annually. The Three Cypress Creek Watershed District will be responsible for the operation and maintenance of all structural measures in Tennessee.

The Cypress Creek Watershed Conservancy District will perform or arrange for the performance of operation and maintenance of the kind that can be accomplished with normal farm equipment in Alabama. The work needed will include the removal of sandbars, undesirable vegetation, logs, stumps, and other debris from the channels. A high degree of maintenance will be required during the first two years following construction. It is estimated that funds amounting to at least 10 percent of construction cost will be required during this period. Vegetation on the floodwater retarding structure and adjacent areas will need to be fertilized adequately to maintain a vigorous growth for protective ground cover. The trash racks and emergency spillways will be cleaned out. This will be carried out through a sub-operation and maintenance agreement between the county governing body and the conservancy district.

A representative of the local sponsoring organizations will make periodic inspections to determine the conditions of the structural works of improvement. A record of maintenance inspections and maintenance operations will be on file with the sponsoring organization. The Soil Conservation Service will assign an employee responsibility for operation and maintenance inspections. The Service employee responsible for operation and maintenance inspections and follow-up and the sponsors will make a joint inspection annually, after unusually severe floods, and after the occurrence of any other unusual conditions that might adversely affect the structural measures. These inspections will continue for three years following installation of each structure. Inspections after the third year will be made annually by the sponsors. They will prepare a report and send a copy to the Service employee responsible for operation and maintenance inspections and follow-up.

In situations where the sponsors have shown lack of ability to properly carry out inspections or where conditions indicate need for continued Service assistance, the Service may continue to provide assistance after the third year. This should be only for special situations as determined by the state conservationist.

The Service employee responsible for operation and maintenance inspections and follow-up will thoroughly review the sponsors' operation and maintenance reports of inspections and maintenance. Evidence that inspections or needed maintenance are not being performed properly and promptly will be reported immediately to the state conservationist, who will then take appropriate action on the reported deficiencies.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Cypress Creek Watershed, Alabama

Installation Cost Item	Unit	Number			Estimated Cost (Dollars) 1/						TOTAL
					P. L. 566 Funds			Other Funds			
		Fed. Land	Non-Fed Land	Total	Fed. Land	Non-Fed. Land	Total	Fed. Land	Non-Fed. Land	Total	
LAND TREATMENT											
Soil Conservation Service											
Cropland	Ac.		5,527	5,527					236,000	236,000	236,000
Grassland	Ac.		8,162	8,162					547,500	547,500	547,500
Technical Assistance						50,000	50,000		25,000	25,000	75,000
SCS Subtotal			13,789	13,789		50,000	50,000		808,500	808,500	858,500
Forest Service											
Forest Land	Ac.		3,600	3,600					93,200	93,200	93,200
Coop. Forest Fire Control						2,000	2,000		37,500	37,500	39,500
Technical Assistance						10,000	10,000		10,800	10,800	20,800
FS Subtotal			3,600	3,600		12,000	12,000		141,500	141,500	153,500
TOTAL LAND TREATMENT			17,389	17,389		62,000	62,000		950,000	950,000	1,012,000
STRUCTURAL MEASURES											
Construction											
Soil Conservation Service											
Floodwater Retarding Str.	No.		9	9		1,305,849	1,305,849				1,305,849
Multiple-Purpose (Rec.)	No.		1	1		223,620	223,620		34,007	34,007	257,627
Channel Improvement	Lin.Ft.	3,650	240,550	243,200	20,561	1,174,875	1,195,435				1,195,436
Subtotal-Construction					20,561	2,704,344	2,724,905		34,007	34,007	
Engineering Services											
Soil Conservation Service					1,645	234,132	235,777		2,721	2,721	238,498
Subtotal-Engineering					1,645	234,132	235,777		2,721	2,721	238,498
Relocation Payments											
Soil Conservation Service						16,500	16,500				16,500
Subtotal-Relocation						16,500	16,500				16,500
Project Administration											
Soil Conservation Service											
Relocation Assistance Advisory Services									500	500	500
Construction Inspection					2,261	309,242	311,503				311,503
Other					1,439	199,390	200,829	150	7,350	7,500	208,329
Subtotal-Administration					3,700	508,632	518,332	150	7,850	8,000	520,332

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Cypress Creek Watershed, Alabama

Installation Cost Item	Unit	Number			Estimated Cost (Dollars) 1/						TOTAL
					P. L. 566 Funds			Other Funds			
		Fed. Land	Non-Fed Land	Total	Fed. Land	Non-Fed. Land	Total	Fed. Land	Non-Fed. Land	Total	
Other Costs											
Land Rights								6,000	851,850	857,850	857,850
Subtotal-Other								6,000	851,850	857,850	857,850
TOTAL STRUCTURAL MEASURES					25,906	3,463,608	3,489,514	6,150	896,428	902,578	4,392,092
TOTAL PROJECT					25,906	3,525,608	3,551,514	6,150	1,846,428	1,852,578	5,404,092
SUMMARY											
Subtotal SCS					25,906	3,513,608	3,539,514	6,150	1,704,928	1,711,078	5,250,592
Subtotal FS						12,000	12,000		141,500	141,500	153,500
TOTAL PROJECT					25,906	3,525,608	3,551,514	6,150	1,846,428	1,852,578	5,404,092

1/ Price Base 1970

Date: December 1971

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Cypress Creek Watershed, Tennessee

Installation Cost Item	Unit	Number Non-Fed. Land	Estimated Cost (Dollars) 1/ P. L. 566 Funds Non-Fed. Land	Other Funds Non-Fed. Land	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Ac.	1,400		77,000	77,000
Grassland	Ac.	2,700		235,000	235,000
Technical Assistance			15,000	7,500	22,500
SCS Subtotal		4,100	15,000	319,500	334,500
Forest Service					
Forest Land		2,100		54,700	54,700
Technical Assistance			6,000	6,400	12,400
Coop. Forest Fire Control				43,700	43,700
FS Subtotal		2,100	6,000	104,800	110,800
TOTAL LAND TREATMENT		6,200	21,000	424,300	445,300
STRUCTURAL MEASURES					
Construction					
Soil Conservation Service					
Floodwater Retarding Str.	No.	9	1,362,850		1,362,850
Channel Improvement	Lin.Ft.	21,000	94,517		94,517
Subtotal-Construction			1,457,367		1,457,367
Engineering Services					
Soil Conservation Service			126,776		126,776
Subtotal-Engineering			126,776		126,776
Relocation Payments					
Soil Conservation Service			6,700		6,700
Subtotal-Relocation			6,700		6,700
Project Administration					
Soil Conservation Service					
Relocation Assistance Advisory Services				300	300
Construction Inspection			163,695		163,695
Other			107,259	6,000	113,259
Subtotal-Administration			270,954	6,300	277,254
Other Costs					
Land Rights				173,200	173,200
Subtotal-Other				173,200	173,200
TOTAL STRUCTURAL MEASURES			1,861,797	179,500	2,041,297
TOTAL PROJECT			1,882,797	603,800	2,486,597
SUMMARY					
Subtotal SCS			1,876,797	499,000	2,375,797
Subtotal FS			6,000	104,800	110,800
TOTAL PROJECT			1,882,797	603,800	2,488,597

1/ Price Base 1970

Date: December 1971

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Cypress Creek Watershed, Alabama & Tennessee

	Unit	Number			Estimated Cost (Dollars) 1/						TOTAL
					P. L. 566 Funds			Other Funds			
		Fed. Land	Non-Fed Land	Total	Fed. Land	Non-Fed. Land	Total	Fed. Land	Non-Fed. Land	Total	
LAND TREATMENT											
Soil Conservation Service											
Cropland	Ac.		6,927	6,927					313,000	313,000	313,000
Grassland	Ac.		10,862	10,862					782,500	782,500	782,500
Technical Assistance						65,000	65,000		32,500	32,500	97,500
SCS Subtotal			17,789	17,789		65,000	65,000		1,128,000	1,128,000	1,193,000
Forest Service											
Forest Land Treatment	Ac.		5,700	5,700					147,900	147,900	147,900
Coop. Forest Fire Control						2,000	2,000		81,200 2/	81,200	83,200
Technical Assistance						16,000	16,000		17,200 3/	17,200	33,200
FS Subtotal			5,700	5,700		18,000	18,000		246,300	246,300	264,300
TOTAL LAND TREATMENT			23,489	23,489		83,000	83,000		1,374,300	1,374,300	1,457,300
STRUCTURAL MEASURES											
Construction											
Soil Conservation Service											
Floodwater Retarding Str.	No.		18	18		2,668,699	2,668,699				2,668,699
Multiple-Purpose (Rec.)	No.		1	1		223,620	223,620		34,007	34,007	257,627
Channel Improvement	Lin.Ft	3,650	261,650	265,300	20,561	1,269,392	1,289,953				1,288,953
Subtotal-Construction					20,561	4,161,711	4,182,272		34,007	34,007	4,216,279
Engineering Services											
Soil Conservation Service					1,645	360,908	362,553		2,721	2,721	365,274
Subtotal-Engineering					1,645	360,908	362,553		2,721	2,721	365,274
Relocation Payments											
Soil Conservation Service						23,200	23,200				23,200
Subtotal-Relocation						23,200	23,200				23,200
Project Administration											
Soil Conservation Service											
Relocation Assistance Advisory Services									800	800	800
Construction Inspection					2,261	472,937	475,198				475,198
Other					1,439	306,649	308,088	150	13,350	13,500	321,588
Subtotal-Administration					3,700	779,586	783,286	150	14,150	14,300	797,588

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Cypress Creek Watershed, Alabama & Tennessee

	Unit	Number			Estimated Cost (Dollars) 1/						TOTAL
					P. L. 566 Funds			Other Funds			
		Fed. Land	Non-Fed Land	Total	Fed. Land	Non-Fed. Land	Total	Fed. Land	Non-Fed. Land	Total	
Other Costs											
Land Rights								6,000	1,025,050	1,031,050	1,031,050
Subtotal-Other								6,000	1,025,050	1,031,050	1,031,050
TOTAL STRUCTURAL MEASURES					25,906	5,325,405	5,351,311	6,150	1,075,928	1,082,078	6,433,389
TOTAL PROJECT					25,906	5,408,405	5,434,311	6,150	2,449,928	2,456,078	7,890,389
SUMMARY											
Subtotal SCS					25,906	5,390,405	5,416,311	6,150	2,203,628	2,209,778	7,626,389
Subtotal FS						18,000	18,000		246,300	246,300	264,300
TOTAL PROJECT					25,906	5,408,405	5,434,311	6,150	2,449,928	2,456,078	7,890,389

1/ Price Base 1970
2/ Includes $8,600 from going Cooperative Forest Program
3/ Includes $25,600 for acceleration of CFFC Program from 1965 Area and Cost Review

Date: December 1971

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Cypress Creek Watershed, Alabama and Tennessee

Measures	Unit	Applied To Date	Total Cost (Dollars)1/
LAND TREATMENT			
Conservation Cropping Systems	Acres	1,961	78,440
Field Border	Feet	9,206	253
Grassed Waterways	Acres	163	27,710
Drainage Mains & Laterals	Feet	38,805	38,805
Pasture and Hayland Planting	Acres	11,372	679,420
Terraces	Feet	192,000	3,840
Farm Ponds	No.	189	81,600
Wildlife Habitat Management	Acres	18	1,800
Diversions	Lin.Ft.	5,350	214
Recreation Area Improvement	Acres	116	58,800
Forest Land Tree Planting	Acres	165	5,445
Stand Improvement	Acres	30	720
TOTAL			977,047

1/ Price Base 1970

Date: December 1971

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Cypress Creek Watershed, Alabama
(Dollars) 1/

Item	Installation Cost - P. L. 566 Funds				Installation Cost - Other Funds				Total Installation Cost
	Construction	Engineering	Relocation Payments	Total P. L. 566	Construction	Engineering	Land Rights	Total Other	
Floodwater Retarding Structures:									
No. 8	89,987	8,999		98,986			12,000	12,000	110,986
11	197,049	15,784		212,833			18,600 2/	18,600	231,433
12	112,607	11,261		123,868			9,400	9,400	133,268
13	141,858	14,186	4,000	160,044			72,600 3/	72,600	232,644
15	148,668	14,867		163,535			25,950	25,950	189,485
16	119,166	11,917	2,000	133,083			18,000 4/	18,000	151,083
17	69,037	8,264		77,301			7,300	7,300	84,601
20	289,581	23,186	3,000	315,767			109,200 5/	109,200	424,967
21	137,896	13,790	4,000	155,686			31,500 6/	31,500	187,186
Multiple-Purpose (Rec.) Structure No. 9	223,620	17,889	3,500	245,009	34,007	2,721	34,100 7/	70,828	315,837
Channel Improvement	1,195,436	95,634		1,291,070			519,200 8/	519,200	1,810,270
Subtotal	2,724,905	235,777	16,500	2,977,182	34,007	2,721	857,850	894,578	3,871,760
Project Administration				512,332				8,000	520,332
GRAND TOTAL	2,724,905	235,777	16,500	3,489,514	34,007	2,721	857,850	902,578	4,392,092

1/ Price Base 1970

Date: December 1971

2/ Includes $5,000 for road relocation
3/ Includes $15,000 for relocation for fixed improvements and $1,000 for road relocation
4/ Includes $2,000 for relocation of fixed improvements
5/ Includes $6,000 for relocation of fixed improvements
6/ Includes $2,000 for relocation of fixed improvements
7/ Includes $5,000 for relocation of fixed improvements and $5,000 for road relocation
8/ Includes $10,000 for road and bridge alteration

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Cypress Creek Watershed, Tennessee
(Dollars) 1/

	Installation Cost-P. L. 566 Funds				Installation Cost-Other Funds		Total Installation Cost
	Construction	Engineering	Relocation Payments	Total P. L. 566	Land Rights	Total Other	
Floodwater Retarding Structures:							
No. 1	92,782	9,278		102,060	11,900 2/	11,900	113,960
2	79,371	7,937	500	87,808	4,900 3/	4,900	92,708
3	207,332	16,607	2,600	226,539	10,375 4/	10,375	236,914
5	95,670	9,567		105,237	6,800	6,800	112,037
6	165,457	13,257	3,600	182,314	20,300 5/	20,300	202,614
7	162,287	13,003		175,290	1,375 6/	1,375	176,665
10	241,517	19,341		260,858	32,350 7/	32,350	293,208
18	171,464	13,737		185,201	24,500 8/	24,500	209,701
19	146,970	14,697		161,667	22,500	22,500	184,167
Channel Improvement	94,517	9,352		103,869	38,200 9/	38,200	142,069
Subtotal	1,457,367	126,776	6,700	1,590,843	173,200	173,200	1,764,043
Project Administration				270,954		6,300	277,254
GRAND TOTAL	1,457,367	126,776	6,700	1,861,797	173,200	179,500	2,041,297

1/ Price Base 1970 Date: December 1971
2/ Includes $500 for relocation of raods
3/ Includes $3,000 for removal of fixed improvements and $1,500 for road relocation
4/ Includes $600 for removal of fixed improvements and $1,000 for road relocation
5/ Includes $1,000 for removal of fixed improvements and $2,500 for road relocation
6/ Includes $1,000 for removal of fixed improvements
7/ Includes $500 for removal of fixed improvements
8/ Includes $1,750 for removal of fixed improvements
9/ Includes $8,000 for alteration of roads and bridges

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Cypress Creek Watershed, Alabama and Tennessee
(Dollars) 1/

Item	Installation Cost - P. L. 566 Funds				Installation Cost - Other Funds				Total Installation Cost
	Construction	Engineering	Relocation Payments	Total P. L. 566	Construction	Engineering	Land Rights	Total Other	
Floodwater Retarding Structures:									
No. 1	92,782	9,278		102,060			11,900 2/	11,900	113,960
2	79,371	7,937	500	87,808			4,900 3/	4,900	92,708
3	207,332	16,607	2,600	226,539			10,375 4/	10,375	236,914
5	95,670	9,567		105,237			6,800	6,800	112,037
6	165,457	13,257	3,600	182,314			20,300 5/	20,300	202,614
7	162,287	13,003		175,290			1,375 6/	1,375	176,665
8	89,987	8,999		98,986			12,000	12,000	110,986
10	241,517	19,341		260,858			32,350 7/	32,350	293,208
11	197,049	15,784		212,833			18,600 8/	18,600	231,433
12	112,607	11,261		123,868			9,400	9,400	133,268
13	141,858	14,186	4,000	160,044			72,600 9/	72,600	232,644
15	148,668	14,867		163,535			25,950	25,950	189,485
16	119,166	11,917	2,000	133,083			18,000 10/	18,000	151,083
17	69,037	8,264		77,301			7,300	7,300	84,601
18	171,464	13,737		185,201			24,500 11/	24,500	209,701
19	146,970	14,697		161,667			22,500	22,500	184,167
20	289,581	23,186	3,000	315,767			109,200 12/	109,200	424,967
21	137,896	13,790	4,000	155,686			31,500 13/	31,500	187,186
Multpile-Purpose Structure No. 9	223,620	17,889	3,500	245,009	34,007	2,721	34,100 14/	70,828	315,837
Channel Improvement	1,289,953	104,986		1,394,939			557,400 15/	557,400	1,952,339
Subtotal	4,182,272	362,553	23,200	4,568,025	34,007	2,721	1,031,050	1,067,778	5,635,803
Project Administration				783,286				14,300	797,586
GRAND TOTAL	4,182,272	362,553	23,200	5,351,311	34,007	2,721	1,031,050	1,082,078	6,433,389

1/ Price Base 1970
2/ Includes $500 for relocation of roads
3/ Includes $3,000 for removal of fixed improvements and $1,500 for road relocation
4/ Includes $600 for removal of fixed improvements and $1,000 for road relocation
5/ Includes $1,000 for removal of fixed improvements and $2,500 for road relocation
6/ Includes $1,000 for removal of fixed improvements
7/ Includes $500 for removal of fixed improvements
8/ Includes $5,000 for road relocation
9/ Includes $15,000 for relocation of fixed improvements and $1,000 for road relocation
10/ Includes $2,000 for relocation of fixed improvements
11/ Includes $1,750 for relocation of fixed improvements
12/ Includes $6,000 for relocation of fixed improvements
13/ Includes $2,000 for relocation of fixed improvements
14/ Includes $5,000 for relocation of fixed improvements and $5,000 for road relocation
15/ Includes $18,000 for alteration of roads and bridges

Date: December 1971

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Cypress Creek Watershed, Alabama and Tennessee

(Dollars) 1/

Item	Cost Allocation			Cost Sharing			
				P.L. 566	Other		
	Flood Prevention	Recreation Water Supply	Total	Flood Prevention	Flood Prevention	Recreation Water Supply	Total
FRS 1,2,3,5,6,7,8,10,11,12, 13,15,16,17,18,19, 20, 21, and Channel Improvement	5,319,966		5,319,966	4,323,016	996,950		996,950
Multiple-Purpose Structure 9	274,147	41,690	315,837	245,009	31,164	39,664	70,828
TOTAL	5,594,113	41,690	5,635,803	4,568,025	1,028,114	39,664	1,067,778

1/ Price Base 1970

Date: December 1971

TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS

Cypress Creek Watershed, Alabama and Tennessee

ITEM	UNIT	FRS Structure No. 6	7	8	9
Class of Structure		b	b	b	b
Drainage Area	Sq.Mi.	5.17	3.44	1.84	5.98
Controlled	Sq.Mi.	---	---	---	---
Curve No. (1-day) (AMC II$\frac{1}{2}$)		80	80	81	79
Tc	Hrs.	2.14	2.28	1.65	2.44
Elevation Top of Dam	Ft.	734.1	729.4	675.6	721.3
Elevation Crest Emergency Spillway	Ft.	728.8	724.6	672.1	715.4
Elevation Crest High Stage Inlet	Ft.		717.4	668.4	---
Elevation Crest Low Stage Inlet	Ft.	702.1	701.2	657.1	701.3
Maximum Height of Dam	Ft.	48.1	42.4	32	43
Volume of Fill	Cu.Yds.	179,117	173,821	81,329	234,465
Total Capacity	Ac.Ft.	1,674	1,188	642	2,127
Sediment Submerged 1st 50 years	Ac.Ft.	100	89	56	---
Sediment Submerged 2nd 50 years	Ac.Ft.	100	88	56	273 2/
Sediment Aerated	Ac.Ft.	34	30	19	47
Beneficial Use (Recreation)	Ac.Ft.	---	---	---	280
Retarding	Ac.Ft.	1,440	981	511	1,527
Between high and low stage	Ac.Ft.	750	499	276	---
Surface Area					
Sediment pool	Acres	21	19	15	48
Beneficial use pool	Acres	---	---	---	72
Retarding pool	Acres	112	79	64	144
Principal Spillway					
Rainfall Volume (areal) (1 day)	In.	6.90	6.9	6.9	6.9
Rainfall Volume (areal) (10 day)	In.	12.60	12.6	12.6	12.6
Runoff Volume (10 day)	In.	7.85	7.85	8.01	7.70
Capacity of Low Stage (Max.)	cfs.	84	55	30	116
Capacity of High Stage (Max.)	cfs.	184	116	104	---
Frequency operation-Emer.Spillway	%chance	2	2	2	2
Size of Conduit	Dim.	36	30	30	30
Emergency Spillway					
Rainfall Volume (ESH) (areal)	In.	8.3	8.3	8.3	8.3
Runoff Volume	In.	5.91	5.91	6.02	5.78
Type		Veg	Veg	Veg	Veg
Bottom Width	Ft.	250	200	200	200
Velocity of flow (Ve)	Ft/Sec	5.7	5.2	4.6	5.2
Slope of exit channel 1/	Ft/Ft	0.034	0.036	0.038	0.031
Maximum water surface elevation	Ft.	730.41	726.07	673.33	716.88
Freeboard					
Rainfall Volume (FH) (areal)	In.	16.5	16.5	16.5	16.5
Runoff Volume (FH)	In.	13.85	13.85	13.97	13.69
Velocity of flow (Ve)	Ft/Sec	10.9	10.6	8.8	11.8
Maximum water surface elevation	Ft.	734.05	729.44	675.64	721.27
Capacity Equivalents					
Sediment Volume	In.	0.85	1.13	1.31	1.01
Retarding Volume	In.	5.22	5.34	5.20	4.79

1/ Based on 25% of ESH discharge
2/ 100 year sediment submerged

Date: December 1971

4-31104

TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS

Cypress Creek Watershed, Alabama and Tennessee

ITEM	UNIT	FRS Structure No. 1	2	3	5
Class of Structure		b	b	b	b
Drainage Area	Sq.Mi.	1.73	1.16	3.34	1.50
Controlled	Sq.Mi.	---	---	---	---
Curve No. (1-day) (AMC II½)		81	81	80	80
Tc	Hrs.	1.07	1.21	1.81	1.18
Elevation Top of Dam	Ft.	930.4	892.0	812.9	802.1
Elevation Crest Emergency Spillway	Ft.	925.7	887.0	806.8	797.1
Elevation Crest High Stage Inlet	Ft.	921.2	881.7	800.0	790.8
Elevation Crest Low Stage Inlet	Ft.	909.2	866.1	783.1	774.7
Maximum Height of Dam	Ft.	37	41	47.9	40.6
Volume of Fill	Cu.Yds.	95,250	76,082	259,243	105,527
Total Capacity	Ac.Ft.	630	403	1,137	501
Sediment Submerged 1st 50 years	Ac.Ft.	53	37	86	41
Sediment Submerged 2nd 50 years	Ac.Ft.	53	37	85	40
Sediment Aerated	Ac.Ft.	18	13	29	14
Beneficial Use	Ac.Ft.	---	---	---	---
Retarding	Ac.Ft.	506	316	937	406
Between high and low stage	Ac.Ft.	259	174	485	217
Surface Area					
Sediment Pool	Acres	14	7	17	8
Beneficial use pool (recreation)	Acres	---	---	---	---
Retarding pool	Acres	59	29	75	36
Principal Spillway					
Rainfall Volume (areal)(1day)	In.	6.9	6.9	6.90	6.90
Rainfall Volume (areal) (10 day)	In.	12.6	12.6	12.60	12.60
Runoff Volume (10 day)	In.	8.01	8.01	7.85	7.85
Capacity of Low Stage (Max.)	cfs.	28	19	54	24
Capacity of High Stage (Max.)	cfs.	66	69	122	70
Frequency operation-Emer.Spillway	%chance	2	2	2	2
Size of Conduit	Dim.	24	24	30	24
Emergency Spillway					
Rainfall Volume (ESH)(areal)	In.	8.3	8.3	8.3	8.3
Runoff Volume (ESH)	In.	6.02	6.02	5.91	5.91
Type		Veg	Veg	Veg	Veg
Bottom Width	Ft.	100	75	125	100
Velocity of flow (Ve)	Ft/Sec	5.2	5.5	5.8	5.6
Slope of exit channel 1/	Ft/Ft	0.035	0.035	0.033	0.034
Maximum water surface elevation	Ft.	927.18	888.62	808.55	798.68
Freeboard					
Rainfall Volume (FH)(areal)	In.	16.5	16.5	16.5	16.5
Runoff Volume (FH)	In.	13.97	13.97	13.85	13.85
Velocity of flow (Ve)	Ft/Sec	10.5	10.9	11.8	10.8
Maximum water surface elevation	Ft.	930.37	891.97	812.91	802.09
Capacity Equivalents					
Sediment Volume	In.	1.34	1.41	1.12	1.16
Retarding Volume	In.	5.48	5.10	5.26	5.08

1/ Based on 25% of ESH discharge

Date: December 1971

4-31104

TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS

Cypress Creek Watershed, Alabama and Tennessee

ITEM	UNIT	FRS Structure No. 10	11	12	13
Class of Structure		b	a	b	b
Drainage Area	Sq.Mi.	8.92	5.75	2.60	7.20
Controlled	Sq.Mi.	---	---	---	---
Curve No. (1-day) (AMC II½)		83	80	79	83
Tc	Hrs.	3.2	3.65	1.93	2.98
Elevation Top of Dam	Ft.	786.6	678.8	655.1	620.9
Elevation Crest Emergency Spillway	Ft.	762.3	674.2	651.0	616.2
Elevation Crest High Stage Inlet	Ft.	754.6	666.6	646.1	---
Elevation Crest Low Stage Inlet	Ft.	736.1	649.0	632.8	600.4
Maximum Height of Dam	Ft.	43	41	36.5	37
Volume of Fill	Cu.Yds.	300,862	219,713	115,300	147,724
Total Capacity	Ac.Ft.	3,167	1,858	876	2,685
Sediment Submerged 1st 50 years	Ac.Ft.	164	102	77	256
Sediment Submerged 2nd 50 years	Ac.Ft.	163	101	76	256
Sediment Aerated	Ac.Ft.	56	35	26	88
Beneficial Use (Recreation)	Ac.Ft.	---	---	---	---
Retarding	Ac.Ft.	2,784	1,620	697	2,085
Between high and low stage	Ac.Ft.	1,427	834	365	---
Surface Area					
Sediment pool	Acres	40	24	17	60
Beneficial use pool	Acres	---	---	---	---
Retarding pool	Acres	204	115	78	243
Principal Spillway					
Rainfall Volume (areal) (1 day)	In.	6.9	6.9	6.9	6.9
Rainfall Volume (areal) (10 day)	In.	12.6	12.6	12.6	12.6
Runoff Volume (10 day)	In.	8.46	7.85	7.70	8.46
Capacity of Low Stage (Max.)	cfs.	148	96	42	154
Capacity of High Stage (Max.)	cfs.	256	181	112	---
Frequency operation-Emer.Spillway	%chance	2	2	2	2
Size of Conduit	Dim	42	36	30	36
Emergency Spillway					
Rainfall Volume (ESH) (areal)	In.	8.3	8.3	8.3	8.3
Runoff Volume (ESH)	In.	6.26	5.91	5.78	6.26
Type		Veg	Veg	Veg	Veg
Bottom Width	Ft.	250	300	200	300
Velocity of flow (Ve)	Ft/Sec	5.7	4.9	4.9	4.5
Slope of exit channel 1/	Ft/Ft	0.032	0.037	0.037	0.040
Maximum water surface elevation	Ft.	764.04	675.50	652.26	617.33
Freeboard					
Rainfall Volume (FH) (areal)	In.	16.5	16.5	16.5	16.5
Runoff Volume (FH)	In.	14.27	13.85	13.69	14.27
Velocity of Flow (Ve)	Ft/Sec	12.3	10.4	9.7	10.5
Maximum water surface elevation	Ft.	768.59	678.81	655.05	620.9
Capacity Equivalents					
Sediment Volume	In.	0.80	0.77	1.29	1.56
Retarding Volume	In.	5.85	5.28	5.03	5.43

1/ Based on 25% of ESH discharge

Date: December 1971

4-31104

TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS

Cypress Creek Watershed, Alabama and Tennessee

ITEM	UNIT	FRS Structure No. 15	16	17	18
Class of Structure		a	a	a	b
Drainage Area	Sq. Mi.	4.36	2.65	1.43	6.61
Controlled	Sq.Mi.	---	---	---	---
Curve No. (1-day) (AMC II$\frac{1}{2}$)		82	84	81	83
Tc	Hrs.	2.64	1.66	1.29	3.23
Elevation Top of Dam	Ft.	702.9	708.3	671.3	815.9
Elevation Crest Emergency Spillway	Ft.	698.8	704.9	667.2	810.50
Elevation Crest High Stage Inlet	Ft.	693.6	700.8	663.3	---
Elevation Crest Low Stage Inlet	Ft.	680.2	688.7	653.7	790.4
Maximum Height of Dam	Ft.	35	34.3	26.6	43
Volume of Fill	Cu.Yds.	153,596	119,900	53,767	191,986
Total Capacity	Ac.Ft.	1,565	1,065	504	2,148
Sediment Submerged 1st 50 years	Ac.Ft.	107	113	40	180
Sediment Submerged 2nd 50 years	Ac.Ft.	107	112	40	176
Sediment Aerated	Ac.Ft.	37	38	14	60
Beneficial Use (recreation)	Ac.Ft.	---	---	---	---
Retarding	Ac.Ft.	1,314	802	410	1,732
Between high and low stage	Ac.Ft.	675	437	214	---
Surface Area					
Sediment pool	Acres	26	25	13	39
Beneficial use pool	Acres	---	---	---	---
Retarding pool	Acres	141	100	50	163
Principal Spillway					
Rainfall Volume (areal)(1 day)	In.	6.9	6.9	6.9	6.9
Rainfall Volume (areal) (10 day)	In.	12.6	12.6	12.6	12.6
Runoff Volume (10 day)	In.	8.46	8.75	8.01	8.46
Capacity of Low Stage (Max.)	cfs.	69	51	23	171
Capacity of High Stage (Max.)	cfs.	165	114	61	
Frequency operation-Emer,Spillway	%chance	2	2	2	2
Size of Conduit	Dim.	36	30	24	36
Emergency Spillway					
Rainfall Volume (ESH)(areal)	In.	8.3	8.3	8.3	8.3
Runoff Volume (ESH)	In.	6.14	6.39	6.02	6.26
Type		Veg	Veg	Veg	Veg
Bottom Width	Ft.	300	300	100	250
Velocity of flow (Ve)	Ft/Sec	4.7	4.3	4.8	5.3
Slope of exit channel 1/	Ft/Ft	.039	0.04	0.037	0.036
Maximum water surface elevation	Ft.	700.01	706.01	668.49	811.98
Freeboard					
Rainfall Volume (FH)(areal)	In.	16.5	16.5	16.5	16.5
Runoff Volume (FH)	In.	14.12	14.42	13.97	14.27
Velocity of Flow (ve)	Ft/Sec	9.7	8.7	9.4	11.3
Maximum water surface elevation	Ft.	702.86	708.33	671.25	815.94
Capacity Equivalents					
Sediment Volume	In.	1.08	1.86	1.23	1.18
Retarding Volume	In.	5.65	5.68	5.37	4.91

1/ Based on 25% of ESH discharge

Date: December 1971

4-31104

TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS

Cypress Creek Watershed, Alabama and Tennessee

ITEM	UNIT	FRS STRUCTURE NO. 19	20	21	TOTAL
Class of Structure		b	c	b	
Drainage Area	Sq.Mi.	5.69	19.03	4.65	93.05
Controlled	Sq.Mi.	---	12.30	---	
Curve No. (1-day) (AMC II½)		82	82	79	
Tc	Hrs.	3.12	7.17	2.88	
Elevation Top of Dam	Ft.	695.7	604.5	598.4	
Elevation Crest Emergency Spillway	Ft.	691.1	594.3	592.3	
Elevation Crest High Stage Inlet	Ft.	---	---	---	
Elevation Crest Low Stage Inlet	Ft.	670.3	566.6	570.7	
Maximum Height of Dam	Ft.	40	61	49	
Volume of Fill	Cu.Yds.	167,179	195,263	148,338	3,018,302
Total Capacity	Ac.Ft.	1,915	7,327	1,574	32,986
Sediment Submerged 1st 50 years	Ac.Ft.	136	477	221	2,335
Sediment Submerged 2nd 50 years		136	467	220	2,586
Sediment Aerated	Ac.Ft.	46	162	75	841
Beneficial Use (Recreation)	Ac.Ft.	---	---	---	280
Retarding	Ac.Ft.	1,597	6,221	1,058	26,944
Between high and low stage	Ac.Ft.	---	---	---	6,612
Surface Area					
Sediment pool	Acres	30	67	31	521
Beneficial use pool	Acres	---	---	---	72
Retarding pool	Acres	150	514	100	2,435
Principal Spillway					
Rainfall Volume (areal)(1 day)	In.	6.9	7.4	6.9	
Rainfall Volume (areal)(10 day)	In.	12.6	13.5	12.6	
Runoff Volume (10 day)	In.	8.31	9.14	7.70	
Capacity of Low Stage (Max.)	cfs.	114	627	120	
Capacity of High Stage (Max.)	cfs.	---	---	---	
Frequency operation-Emer.Spillway	%chance	2	1	2	
Size of Conduit	Dim.	30	60	30	
Emergency Spillway					
Rainfall Volume (ESH)(areal)	In.	8.3	12.56 3/	8.3	
Runoff Volume (ESH)	In.	6.14	9.28 4/	5.78	
Type		Veg	Veg	Veg	
Bottom Width	Ft.	300	700	150	
Velocity of Flow (Ve)	Ft/Sec	5.1	9.7	6.2	
Slope of exit channel 1/	Ft/Sec	.036	.024	.032	
Maximum water surface elevation	Ft.	692.52	598.52	594.13	
Freeboard					
Rainfall Volume (FH) (areal)	In.	16.5	31.73 3/	16.5	
Runoff Volume (FH)	In.	14.12	28.05 4/	13.69	
Velocity of flow (Ve)	Ft/Sec	10.4	16.2	12.1	
Maximum water surface elevation	Ft.	695.72	604.47	598.38	
Capacity Equivalents					
Sediment Volume	In.	1.05	1.09	2.06	
Retarding Volume	In.	5.26	6.13	4.27	

1/ Based on 25% of ESH discharge
3/ Adjusted for D.A. and storm duration
4/ Used AMC II

Date: December 1971

4-31104

TABLE 3A - STRUCTURE DATA
CHANNELS
Cypress Creek Watershed, Alabama and Tennessee

Channel Name	Reach Station 100 ft.	Reach Station 100 ft.	Drainage Area sq.mi.	Capacity Req'd cfs	Capacity Design cfs	Water Surface Elev. 1/	Hydraulic Gradient (ft./ft.)	Channel Dim. 2/ Bottom (ft.)	Channel Dim. 2/ Depth (ft.)	"n" value 3/ Aged	Velocities Aged	Velocities As Built	Vol. of Excavation Common 1,000 cu.yd.	Vol. of Excavation Rock cu.yd.	Riprap cu.yd.
Cypress Creek	357+00	373+00	9.65	700	727	691.0	0.0056	24	4.2	0.040	6.16	8.21	6.5		
	373+00	430+00	11.00	1,200	1,226	665.2	0.0045	43	4.0	0.035	6.52	9.13	46.0		
	430+00	558+00	14.13	1,400	1,397	614.5	0.0040	48	4.2	0.035	6.38	8.93	123.4		460
	558+00	642+00	16.64	1,550	1,528	584.8	0.0035	56	4.2	0.035	6.04	8.46	100.0		
	642+00	676+00	20.61	1,850	1,851	573.0	0.0035	68	4.2	0.035	6.11	8.55	52.0		
	676+00	735+00	22.58	2,000	1,950	555.5	0.0029	76	4.2	0.035	5.67	7.94	93.0		
	735+00	773+00	23.35	2,100	2,081	543.1	0.0033	76	4.2	0.035	6.05	8.47	61.7		
	773+00	828+00	25.32	2,275	2,274	528.4	0.0027	76	4.8	0.035	5.86	8.20	82.5		
	828+00	859+00	44.45	3,800	3,788	520.0	0.0027	104	5.4	0.035	6.41	8.97	90.5		
	859+00	919+00	45.21	3,900	3,880	511.0	0.0015	101	6.6	0.030	6.22	7.46	152.0		900
	919+00	965+00	54.63	4,800	4,769	505.8	0.0012	88	8.0	0.030	6.21	7.45	116.0		
	965+00	1026+00	69.79	5,100	5,168	496.4	0.0015	88	7.8	0.030	6.90	8.39	158.0	50	1,245
	1016+00	1247+00	78.77	5,400	5,403	462.5	0.0011	108	7.8	0.030	5.97	7.16	283.0	1,000	2,485
Dulin Br.	418+00	437+00	0.53	116	150	662.5	0.0060	4	4.0	0.040	4.70	7.52	2.1		
North Fork	533+00	558+00	0.29	104	356	614.5	0.0044	14	4.0	0.040	4.94	7.90	7.0		
Threet Cr.	600+00	642+00	3.44	370	359	584.8	0.0050	12	4.2	0.040	5.28	8.45	14.0		
Middle Cypress Creek	391+00	447+00	2.03	385	379	667.3	0.0050	14	4.0	0.040	5.27	8.43	22.4		
	447+00	487+00	3.15	445	430	647.5	0.0050	16	4.0	0.040	5.38	8.61	19.2		360
	487+00	523+00	4.45	500	513	627.5	0.0055	12	5.0	0.040	6.04	9.66	9.1		
	523+00	616+00	6.79	710	723	590.5	0.0040	18	5.0	0.035	6.29	8.81	42.0		
	616+00	650+00	8.73	880	856	577.2	0.0038	22	5.0	0.035	6.34	8.88	20.0		
	650+00	738+00	10.61	1,060	1,067	551.3	0.0029	32	5.0	0.035	5.77	8.08	53.0		700
	738+00	806+00	13.98	1,400	1,404	531.5	0.0029	38	5.4	0.035	6.13	8.58	68.0		
	806+00	828+00	14.22	1,400	1,428	528.2	0.0015	44	5.4	0.030	5.25	7.35	2.22		

1/ Elevation at lower end of reach
2/ All channel designed with 1:1 side slope
3/ "n" Value as built is 0.025 for all channels
Type of improvement is channel enlargement.

Date: December 1971

TABLE 3A - STRUCTURE DATA
CHANNELS
Cypress Creek Watershed, Alabama and Tennessee

Channel Name	Reach Station 100 ft.	Reach Station 100 ft.	Drainage Area sq.mi.	Capacity Req'd cfs	Capacity Design cfs	Water Surface Elev. 1/	Hydraulic Gradient (ft./ft.)	Channel Dim. 2/ Bottom (ft.)	Channel Dim. 2/ Depth (ft.)	"n" value 3/ Aged	Velocities Aged	Velocities As Built	Vol. of Excavation Common 1,000 cu.yd.	Vol. of Excavation Rock cu.yd.	Riprap cu.yd.
Latham Branch	606+00	610+00	0.50	110	156	590.5	0.0065	4	4.0	0.040	4.89	7.82	1.5		
Green-briar Branch	715+00	738+00	2.40	440	460	551.3	0.0035	10	5.4	0.035	5.55	7.77	4.4		
Spring Branch	716+00	745+00	3.52	460	461	552.0	0.0053	14	4.4	0.040	5.96	9.10	9.0		
	745+00	768+00	4.00	510	520	542.5	0.0040	16	4.4	0.035	5.78	8.09	8.1		200
	768+00	806+00	4.39	550	551	531.5	0.0029	16	5.0	0.035	5.25	7.35	17.2		
Lindsey Creek	645+00	717+00	2.16	380	377	585.8	0.0047	12	4.4	0.040	5.24	8.38	21.0		
	717+00	748+00	2.67	420	411	572.7	0.0042	14	4.4	0.040	5.07	8.11	7.0		
	748+00	805+00	4.58	550	561	548.9	0.0042	17	4.4	0.035	5.97	8.36	16.8		
	805+00	837+00	6.64	665	688	535.1	0.0042	21	4.4	0.035	6.14	8.60	17.0		
	837+00	888+00	7.91	720	746	518.5	0.0032	21	5.0	0.035	5.74	8.04	26.1		
	888+00	919+00	8.66	760	792	511.0	0.0024	26	5.0	0.035	5.11	7.15	20.2		
Burcham Creek	627+00	693+00	2.10	345	347	588.0	0.0045	18	3.4	0.040	4.75	7.60	26.0		
	693+00	713+00	2.60	385	406	579.6	0.0041	14	4.4	0.040	5.01	8.02	8.8		
	713+00	783+00	7.26	730	735	557.5	0.0031	17	5.6	0.035	5.81	8.13	29.4		
	783+00	834+00	9.40	910	935	541.7	0.0031	22	5.6	0.035	6.03	8.44	27.8		
	834+00	866+00	11.46	1,060	1,087	536.0	0.0018	23	6.4	0.030	5.78	6.94	23.6		
	866+00	922+00	13.26	1,200	1,176	515.0	0.0037	20	6.4	0.035	6.96	9.74	31.0		
	922+00	965+00	14.42	1,300	1,340	505.8	0.0022	23	6.8	0.030	6.60	7.92	18.0		
Bruton Branch	636+00	653+00	1.55	245	242	607.2	0.0054	10	3.6	0.040	4.93	7.89	6.0		
	653+00	692+00	2.26	315	323	588.4	0.0048	12	4.0	0.040	5.05	8.08	5.5		
	692+00	713+00	2.62	350	361	579.6	0.0043	12	4.4	0.040	5.02	8.03	6.0		

1/ Elevation at lower end of reach
2/ All channel designed with 1:1 side slope
3/ "n" Value as built is 0.025 for all channels
Type of improvement is channel enlargement

Date: December 1971

TABLE 3A - STRUCTURE DATA
CHANNELS
Cypress Creek Watershed, Alabama and Tennessee

Channel Name	Reach Station 100 ft.	Reach Station 100 ft.	Drainage Area sq.mi.	Capacity Req'd cfs	Capacity Design cfs	Water Surface Elev. 1/	Hydraulic Gradient (ft./ft.)	Channel Dim.2/ Bottom (ft.)	Channel Dim.2/ Depth (ft.)	"n" value3/ Aged	Velocities Aged	Velocities As Built	Vol. of Excavation Common 1,000 cu.yd.	Vol. of Excavation Rock cu.yd.	Riprap cu.yd.
Little Cypress Creek	369+00	401+00	2.73	420	422	683.0	0.0053	14	4.2	0.040	5.55	8.88	12.7		
	401+00	428+00	3.73	450	452	669.7	0.0049	12	4.8	0.040	5.58	8.93	8.0		
	428+00	451+00	4.18	465	502	655.5	0.0062	10	5.2	0.040	6.35	10.16	9.0		
	451+00	484+00	4.76	480	502	635.0	0.0062	10	5.2	0.040	6.35	10.16	13.0		
	484+00	495+00	5.35	500	498	630.9	0.0037	11	5.4	0.035	5.60	7.84	3.5	25	
	588+00	599+00	7.65	670	663	600.5	0.0028	25	4.4	0.035	5.14	7.20	4.5		
	599+00	646+00	11.26	920	922	586.0	0.0031	33	4.4	0.035	5.59	7.83	30.6		
	646+00	721+00	12.19	980	968	571.5	0.0019	36	5.0	0.035	4.72	6.61	32.0	25	
	977+00	992+00	4.89	720	739	512.5	0.0025	32	4.2	0.035	4.86	6.80	9.0		
	992+00	1001+00	7.86	820	809	510.0	0.0025	35	4.2	0.035	4.90	6.86	3.4		
	1001+00	1047+00	7.86	820	808	505.0	0.0014	35	5.0	0.035	4.04	5.66	20.0		
	1176+00	1247+00	13.70	1,325	1,316	472.5	0.0015	43	5.8	0.035	4.65	6.51	32.0	50	1,000
Chisholm Branch	964+00	992+00	2.13	305	319	512.5	0.0047	12	4.0	0.040	4.99	7.98	8.0		

1/ Elevation at lower end of reach
2/ All channel designed with 1:1 side slope
3/ "n" Value as built is 0.025 for all channels
Type of improvement is channel enlargement.

Date: December 1971

TABLE 4 - ANNUAL COST

Cypress Creek Watershed, Alabama

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
FRS 8, 11, 12, 13, 15, 16, 20, 21, multiple-purpose structure 9, channel improvement	209,229	32,721	241,950
Project Administration	28,118		28,118
GRAND TOTAL	237,347	32,721 3/	270,068

1/ Price base installation 1970; O&M adjusted normalized
2/ 100 years at 5 3/8%
3/ Includes $14,358 for operation, maintenance, and replacement for the recreational development

Date: December 1971

TABLE 4 - ANNUAL COST

Cypress Creek Watershed, Tennessee

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
FRS 1, 2, 3, 5, 6, 7, 10, 18, 19, channel improvement	95,328	2,745	98,073
Project Administration	14,982		14,982
GRAND TOTAL	110,310	2,745	113,055

1/ Price base installation 1970; O&M adjusted normalized
2/ 100 years at 5 3/8%

Date: December 1971

TABLE 4 - ANNUAL COST

Cypress Creek Watershed, Alabama and Tennessee

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
FRS 1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, multiple purpose structure 9, channel improvement	304,558	35,466	340,024
Project Administration	43,101		43,101
GRAND TOTAL	347,659	35,466 3/	383,125

1/ Price base installation 1970; O&M adjusted normalized
2/ 100 years at 5 3/8%
3/ Includes $14,358 for operation, maintenance, and replacement for the recreational development

Date: December 1971

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Cypress Creek Watershed, Alabama and Tennessee

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Crop and Pasture	198,670	39,930	158,730
Other Agriculture	30,948	7,454	23,494
Nonagriculture			
Road and Bridge	15,974	3,092	12,882
Subtotal	245,592	50,486	195,106
Erosion			
Floodplain Scour	8,713	3,108	5,605
Indirect	25,080	5,822	19,258
TOTAL	279,385	59,416	219,969

1/ Price base, adjusted normalized

Date: December 1971

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Cypress Creek Watershed, Alabama & Tennessee

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/									Average Annual Cost 2/	Benefit Cost Ratio
	Damage Reduction	More Intensive Land Use	Changed Land Use Agr.	Recrea-tion	Land Use and Development	Incidental Recreation	Secon-dary	Redevel-opment	Total		
FRS 1,2,3,5,6,7,8, 10,11,12,13,15,16, 17,18,19,20,21, multiple-purpose structure 9, channel improvement	210,509	111,153	26,795	63,920	39,237	13,538	55,549	73,547	594,249	340,024	1.7 :1
Project Adminis-tration										43,101	
GRAND TOTAL	210,509 3/	111,153	26,795	63,920	39,237	13,538	55,549	73,547	594,249	383,125	1.6:1

1/ Price base 1969
2/ From Table 4
3/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $9,460 annually

Date: December 1971

INVESTIGATIONS AND ANALYSES

Economic

Basic data used for the economic investigations and analyses were obtained from local farmers, agricultural workers, experiment stations, and Department of Agriculture publications.

Project benefits and operation and maintenance costs were based on adjusted normalized price data included in the "Interim Price Standards for Planning and Evaluating Water and Land Resources", April 1966. Current prices (1970) were used for estimating the cost of land treatment and structural measures. The cost of structural measures was amortized over a 100-year period using an interest rate of 5 3/8%.

Landowners and operators in the flood plain were interviewed to determine present land use and yields, projected use and yields with protection from flooding, and percent damage factors by depths of inundation to crops and fixed improvements. This scheduled information was summarized and evaluated. Projected crop distribution was determined. Flood damages with and without the project were determined by using a synthetic storm series in the Econ 2 computer program. Six storms were used in the frequency analysis.

More intensive use benefits were calculated on the basis of the expected increase in crop yields. This increase in yield will result from increased use of fertilizers and better managerial practices made profitable by reduced flood hazard. Flood damages to higher values were deducted from gross benefits.

Land damage benefit calculations from flood plain scour were based on the method where damage and recovery are in equilibrium. Recovery of productivity is occurring at approximately the same rate as damage.

Data used in the evaluation was furnished by the geologist and included area damaged, percent reduction in yield, and amount of recoverable damage. Other information on prices, costs, and returns for crop production complete the basic data. The percent reduction was determined by using the method in chapter 5 of the Economics Guide.

Benefits from restoration to former productivity and changed land use were evaluated on the basis of increases in net income from the reduction of flood hazards. Associated costs and increased damages to higher values were deducted. To avoid double counting, restoration to former productivity and changed land use benefits were evaluated together; and the benefits were divided based on interviews with landowners, agricultural workers, and field observation.

Benefits from recreation and instruction for Structure No. 9 were based on the estimated number of visitor-days of use by Florence State University. The value of a visitor-day was estimated to be $1.50. Cost of basic facilities which included sanitary facilities was treated as associated costs and deducted from gross benefits.

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Benefits from the enhanced land value surrounding Site Nos. 20 and 21 were determined by deducting the present land value and development costs from the value of the land with the reservoirs completed. These developments were underway before this plan was begun. The benefits are incidental and will accure to a number of beneficiaries.

The evaluation of local secondary benefits stemming from the project was derived by applying a ten-percent factor to the sum of all primary project benefits (excluding indirect and redevelopment benefits). Local secondary benefits induced by the project were based on the difference in total production cost of crops and pasture with and without project. A ten-percent factor was applied to this difference in production cost and also to the annual equivalent associated cost to get the gross annual secondary benefits.

Redevelopment benefits resulting from installation of project measures are based on utilization of unemployed local labor. The amount of construction cost spent for local labor was estimated to be about 30 percent based on interviews and available performance records from other watersheds. Thirty percent of the construction cost was converted to an annual equivalent by amortization at 5 3/8 percent interest over a 100-year period. Redevelopment benefits resulting from employment in operation and maintenance of structural measures were estimated by taking 50 percent of the O & M cost and dividing by 25 years to obtain the rate of decline. This was multiplied by the present value of a decreasing annuity to obtain the present capital value. The present capital value was amortized at 5 3/8 percent for 100 years to obtain average annual benefits.

Incidental recreation benefits of the project were calculated on the value of visitor-days per year at floodwater retarding structure sites. The number of visitor-days was determined by multiplying the sediment pool area of structure times the visitor-days per surface area. Annual use per surface acre was conservatively estimated as 65 visitor-days. Consideration was given to attendance data published by the Alabama Department of Conservation and factors affecting visitor-days such as size and location of the area available for recreation use, expected development of recreational facilities, population and population trend for surrounding area, expected competitive recreational areas, and opportunities for different kinds of recreational use. The value of a visitor-day was estimated at $0.50. Annual incidental recreational benefits were determined by multiplying $0.50 times the number of annual visitor-days less associated costs. Associated costs include sanitary facilities, access roads and picnic tables. To account for loss of usefullness because of sedimentation, benefits were discounted on the basis that benefits will accrue at a full level for 40 years and decrease to nothing in 10 years.

The value of land rights including the estimated cost of road and bridge alterations were furnished by the Cypress Creek Watershed Conservancy District and the Three Cypress Creek Watershed District. Values of land needed for structural measures were compared with values of comparable land in the watershed. Estimates were based on current market values. The loss of net income in the pool areas of the flood water retarding structures was found to be less than the amortized value of land rights; therefore, there

is no other economic cost applicable to the project.

Engineering

Nineteen dam sites were investigated and planned for installation (see project map). Planning investigations indicate that the structures will have to be supplemented with channel improvement to give the desired level of flood protection and meet other project objectives.

The principal spillway design storm for each site was computer-routed through various pipe sizes with single-stage and two-stage inlets. Appropriate pipe size and type inlet were selected based on cost and feasibility so as to meet overall project objectives.

After the appropriate principal spillway was selected, the emergency and freeboard design hydrographs for each site were computer routed using various emergency spillway dimensions. The required excavation for the various spillway dimensions were determined. No spillway dimension was selected where the required excavation provided more than 80 percent of embankment material. The topographic condition that was most economical and best met the project objectives was used in selecting the spillway dimensions for each site.

Structure No. 20 is a lower site in series with two sites upstream. The principal spillway determination was based on computer routing of the design storm runoff with a II$\frac{1}{2}$ AMC from the uncontrolled area plus the principal spillway outflow from upstream structures through three different pipe sizes. The most feasible selection was made. Two sets of design storms were developed for the emergency and freeboard hydrographs. The time of concentration for the total D.A. and uncontrolled D.A. was determined and adjustments made in design storm duration. The first set of storms was computer-routed using uncontrolled drainage area only. The second set of storms was computer-routed using total drainage area with upstream structures in place. The emergency and freeboard routings were made using an AMC II. The second set of storms gave the most severe flow condition at Site No. 20. The dimensions of the emergency spillway were based on the most severe condition.

A field study was made of streams within the watershed after making a stereoscopic study of aerial photographs. Information gathered from this study, field survey notes, and the hydrologic-economic investigation of the watershed were used in determining the amount and centerline location of channel improvement. The centerline was then checked in the field.

Cypress Creek channel from station 1247+00 (confluence Little Cypress Creek) upstream to station 965+00 (confluence Burcham Creek) is designed to accomodate the peak flow produced by a 0.7-year frequency 24-hour duration storm. All other channels to be improved are designed to accomodate the peak flow produced by an 0.8-year frequency 24-hour duration storm. Manning's "n" values for design were selected in accordance with Chapter 6, Section 16, of the National Engineering Handbook.

Hydraulic and Hydrologic

A synthetic storm series was used in evaluating the watershed. Six storms selected from the U. S. Weather Bureau publication "Rainfall Frequency Atlas of the United States, Technical Paper No. 40" were valley flood routed through the watershed. These were the 100-year, 25-year, 10-year, 2-year, 1-year, and 0.2-year frequency 24-hour duration storms.

Consideration was given to soil classification, land use, and vegetative cover in determining the antecedent moisture condition II future curve number 72 for the watershed. This curve number was used in accordance with Technical Release No. 16, "Rainfall-Runoff Tables for Selected Runoff Curve Numbers," in determining inches runoff for storms to be routed.

The convex method of valley flood routing was performed using the IBM Computer 7094 and Technical Release 20, Project Formulation Program--Hydrology. The six above mentioned storms were routed through four alternates or watershed conditions. The first alternate was future condition without project. Second, third, and fourth alternates were various combinations of floodwater retarding structures supplemented by stream channel improvement. Peak flows from the first alternate checked favorably with a Log Pearson Type III flow frequency analysis of stream flow at a gage 4 miles upstream from the mouth of Cypress Creek. The fourth alternate was found to be the most desirable combination of structural measures and was proposed for installation.

Stage versus discharge, end area, flood plain width, and acres of flood plain inundated were developed for 52 valley cross-sections with the use of the Monrobot computer and field data collected at the cross-section locations. Stage-discharge relationships were developed for an additional 121 channel cross-sections by use of Manning's formula.

A reservoir operation study was made for multiple-purpose Structure No. 9, which is to contain recreation water in addition to floodwater storage. This study covered the driest period of record, 1939 to 1946 (inclusive), and it was found that the supply exceeded the demand for recreational purposes.

Geologic

Maps and reports reviewed include the geologic maps of Lauderdale County, Alabama, 1/ and Wayne County, Tennessee 2/.

Preliminary site investigations were performed at nineteen damsites. The sites were investigated by inspection of the surface and a few hand

1/ H. B. Harris, R.R. Peace, Jr. and W. F. Harris, Jr., Geology and Ground Water Resources of Lauderdale County, Alabama, Geologic Survey of Alabama County Report 8. (University, Alabama, 1963).

2/ U. S. Department of the Interior, Ground Water in South-Central Tennessee, Geological Survey-Water Supply Paper 677. (Washington: U.S. Government Printing Office, 1936).

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auger borings. Conclusions were based in part on reports of detailed damsite investigations at two sites in Weatherford-Bear Creek Watershed, Wayne County, Tennessee. Geological problems are similar throughout the watershed. The Mississippian Tuscumbia (St. Louis of Tennessee reports) and Fort Payne formulations weather to deep gravelley soils, which are similar to the Tuscaloosa gravels, silts, and clays on the western side of the watershed. Depth to bedrock varies from 50 to 100 feet 2/. Foundations are expected to be firm gravelley silts and clays. Borrow materials are plentiful and mostly gravelley ML's and SM's. The borrow materials will come from emergency spillways and adjacent hill locations.

Flood plain scour and sediment damages were estimated by linear measurement of the damage on valley cross-sections and expanding the damage to the acreage represented by the sections. Valley sections used were the same as those used by the hydrologist and economist in flood damage computation. Damage and recovery factors were determined jointly in the field by the geologist and area soil scientist.

Channels

Channel stability investigations and analyses consisted of four phases: (1) recognition of gradient, velocity, and bedload problems; (2) sampling of bank and bed materials and analyses of soil properties; (3) hydraulic and stability design including bedload transport analyses; (4) comparison with other channels and analyses of climatic, soil, and vegetation factors.

Initial studies of slopes and channel materials indicated that channel stability would be a problem. Stream gradients range from 0.0011 to 0.0065 feet per foot. There are a few areas where bad alignment of the stream has caused some bank cutting. The central and upper portion of the watershed has channels which are partially filled with gravel and sand. These factors led the planning staff to secure assistance from the E&WP Unit. The size of the bed materials and silting of channels indicated that preliminary bedload transport studies should be made. The preliminary studies showed that channel velocities must be kept high to maintain the present rate of bedload transport and prevent significant aggradation to the channel bed. A more detailed stability study was recommended and carried out during full scale planning. As more knowledge of gradient and soils became available, it was evident that bank instability would be a serious hazard.

Channel studies indicate that the present channels are gradually filling with large, gravelley material which will tend to fill the channels more rapidly if flood peak flows are reduced. Channel bottom materials were sampled and tested for size distribution. Future bedload movement was analyzed using two different channel designs with a storm producing 1.39 inches of runoff, approximately the average annual event. This analysis indicates that the channels will tend to fill in some reaches and scour in others but the total accumulation or degradation in any reach will be small. Bank materials were sampled and tested for size distribution and plasticity.

2/ U. S. Department of the Interior, Ground Water in South-Central Tennessee, Geological Survey-Water Supply Paper 677. (Washington: U. S. Government Printing Office, 1936).

The materials are slightly plastic to non-plastic with D_{75} sizes ranging from coarse sand to coarse gravel.

The Musgrave Soil Loss Equation was used in calculating sheet erosion rates. Erosion calculations were based on four site drainage areas in which land use, cover, and slope were studied in detail. The remaining site area erosion rates were computed using averages from the four detailed studies and the present land use distribution as mapped on aerial photographs. Sediment delivery ratios were estimated using a curve relating size of drainage area to percentage of delivered sediment. Sediment storage requirements were projected for 100-year life of structures. The sediment pool elevation is set by the capacity required to store the predicted submerged sediment accumulation. Additional capacity for aerated sediment will be provided in the detention pool for that portion of the sediment expected to remain above the submerged pool elevations.

Volume weight of soil for erosion computation averages 95 pounds per cubic foot. Volume weights used in computing needed volume of sediment are 60 pounds per cubic foot for submerged sediment and 87 pounds per cubic foot for aerated sediment.

Bank soil profiles are remarkably similar throughout the watershed. In upstream areas, two to three feet of gravelly ML overlies silty GM. Further down the watershed the depth of ML increases to about 4 feet or roughly the upper one-third of the stream bank throughout the watershed. This upper third of the bank is non-cohesive ML which is easily eroded, but because of its position is not as vunerable to high velocity attack as the lower two-thirds of the bank.

The materials of the lower two-thirds of the banks were sampled at 16 locations. This material is typically GW or GP and gravelley SW or SP. These are mostly angular to sub-rounded quartzite and chert-fragments in the coarse sand to cobble size ($\frac{1}{2}$ inch to 3 inches and larger).

Bed materials were sampled at 19 locations. These samples were taken at low water from the mid-bar. They represent average bed materials which become bedload during high flows. Sieve analysis of bed materials indicate them to be clean GW's, GP's and gravelley SW's and SP's. These are mostly sub-angular to sub-rounded quartzite and chert fragments in the range of coarse sand to cobble sizes.

Hydraulic designs were made to follow natural gradients by keeping hydraulic gradient parallel to the ground line. Alternatives were examined which would give very large width-to-depth ratios and/or lower gradients by means of drop structures. The first alternative was eliminated as impractical as it would have produced channels much shallower than the present natural channels and would have aggravated the present tendency of the channels to fill with gravel. The alternative with drop structures was eliminated because the crops would have been very deep or very close together; in either case, large quantities of rock and heavy cobble excavation would have resulted and the cost of these structures would be prohibitive in this agricultural flood control channel.

The proposed designs call for depths that follow the bottom of the

existing channels without excessive cuts into cobble or rock shoals. In general, design depths range from 3.4 to 8.0 feet and widths from 4 to 108 feet. The "n" values are related to the hydraulic radius of the channel and are in keeping with Section 16, National Engineering Handbook. They range from 0.030 to 0.040 for "aged" condition. Design velocities for "aged" conditions range from 5.67 feet per second to 6.96 feet per second. Most design velocities are less than 6.5 feet per second. Those reaches having velocities over 6.5 feet per second are also some of the reaches which have rock ledges controlling gradient. Velocities under "as built" conditions range higher, of course, when using an "n" value of 0.025 to represent roughness soon after construction. These velocities range from 7.28 feet per second to 10.16 feet per second. It is important to note that "n" values of 0.025 are probably unrealistic for channels having rock ledges, heavy gravel and cobble roughness in the bed and which will be cut from one side only leaving one vegetated side. Velocities are necessarily high because of (1) the bedload, (2) the gradients of the streams, and (3) release flows from structures.

Permissible velocities as given in Technical Release 25 range up to 8.25 feet per second for grain sizes up to 24 millimeters D_{75} size. Future bedload movement was analyzed using the Meyer-Peter equation and two different channel designs with a storm producing 1.39 inches of runoff, approximately the average annual event. This analysis indicates that channels will tend to fill in most reaches and scour in a few reaches, but that total accumulation or degradation in any one reach will be small (42 out of 67 reaches show aggradation). Possibly of most significance is the finding that all but 6 of 67 reaches show aggradation tendency with the controlled storm flow only. This means that design velocities are set low enough to avoid significant soil movement during high flows. Bed material movement will continue until release flows from floodwater retarding structures have subsided, but these release flows will be well within banks and thus will not strongly attack the vunerable ML soils of the upper one-third of the channel banks.

Descriptions of the bedload are not complete without an indication of the source and supply. Soils are generally gravelly throughout the watershed so that any erosion produces some gravel. This means that gravel is introduced into the streams throughout the watershed, thus treatment of a few critical areas would not eliminate the bedload problem. The few critical areas delivering gravel to the stream system are presently being treated. Most serious source of gravel seems to be the surface of unpaved roads and their road ditches.

Initial studies of the bedload and the sediment filled channels in the mid-portion of the watershed led to the fruitless search for a huge sediment choked area. Channel plugging with resultant sediment spread over the flood plain is imminent but not presently severe (see Watershed Problems--Sediment Damage).

Comparisons of stable channels in the watershed and surrounding area were made by E&WP and state watershed planning staff personnel. In the watershed, Greenbrier Creek and Lindsey Creek channels are obviously stable and successful. However, design criteria is not available on these channels.

nor is their exact age, shape, and history known. Greenbrier Creek was dug about 10 years ago and Lindsey Creek channel was excavated by blasting about 20 years ago; both are in excellent condition and are good examples of what can be expected in Cypress Creek Watershed.

Channels in three P. L. 566 watershed projects were also observed by E&WP and state staff personnel. Although none of these three watersheds has the exact soil conditions as Cypress Creek Watershed, they do show the results of aging, vegetation of berms, maintenance, and climate in this area. Town Creek and Big Nance Creek channels are in Franklin and Lawrence Counties, Alabama and Clear Creek is in Jackson County, Alabama.

The Town Creek channels were about 1½ years old and in good condition. The berms and spoil had been seeded to Fescue and White Clover, which was standard practice in Alabama at the time. Although some of the bank areas were not completely vegetated, serious soil losses were not evident. This reveals that Fescue and Clover can be expected to grow on the berms and spoil in Cypress Creek Project. Also, that natural vegetation tends to come in on side slopes of excavated channels in two to three years.

Two locations on Town Creek channel were observed. At Station 1068+00 drainage area was 34 square miles, design capacity 2,667 cubic feet per second, design velocity for "aged" conditions was 4.47 feet per second "n" value 0.030; gradient of 0.00070 feet per foot. The channel was dug 65 feet wide and 7.5 feet deep and has flowed bank-full several times since construction. Very little soil loss was evident though "as buil t" velocities may have been 6.0 to 6.5 feet per second.

At Town Creek Station 1886+00, the design discharge was 1,521 cubic feet per second with a gradient of 0.0010 feet per foot, a constructed width of 62 feet and depth of 6 feet. The velocity for "aged" conditions was 4.59 feet per second. This channel has been subjected to the same conditions as described above with the same satisfactory result.

The Big Nance Creek Watershed channel was constructed in 1966, three years before our observation. The berms were vegetated in the fall of 1966. We observed the channel at Station 1552+00 where it had a design width of 54 feet, depth of 6.0 feet, and velocity of 3.97 feet per second under "aged" conditions. This channel was in cohesive soil and was silting slightly downstream from the point of observation and scouring slightly upstream from the observation point. The inside bank of the curve was well vegetated but the outside bank was not fully covered. Slight soil loss was noted on the outer slopes. Big Nance channel has flowed bankfull several times in three years with very little soil loss, although, "as built" velocities of 6.0 feet per second have probably been reached several times.

Clear Creek channel was constructed in 1958 and has been observed from time to time throughout its life by state and various E&WP personnel. At Station 107+00, Clear Creek has a design discharge of 675 cubic feet per second, with gradient 0.0022 feet per foot, "aged" velocity of 4.3 feet per second with "n" value of 0.040. This channel had stabilized well and is performing satisfactorily though "as built" velocities approached 7.0 feet per second. Clear Creek channel degraded slightly and scoured the

banks slightly during the first year after construction. Soils are non-cohesive silts with some gravel. Channel maintenance costs were somewhat high the first year or two but have tapered down as the channel has stabilized. This channel has never eroded at a significant rate nor lost its functional shape and is considered to be very satisfactory.

A summary of design criteria assumptions was made for Cypress Creek channel planning in conference with E&WP personnel, state conservation engineer, design engineer, and state planning staff. Climate, soil, and vegetation factors were evaluated along with two trial designs. Suggestions for improving the design were incorporated as agreed upon and the third alternative channel design is the one which is included in this plan.

It was agreed that the climate will allow fast growth of vegetative cover. Spoil berms and bank slopes will be seeded immediately following excavation. Some vegetation can be seeded and expected to grow during any season with the mild temperature, soil fertility, and 4 1/3 inches per month rainfall average. Channels will be inspected one year after excavation and reseeding done in key spots of poor vegetative cover.

These procedures are standard for Alabama watershed work.

Minor soil loss is anticipated during the first two years after excavation and the sponsors expect to spend up to 10 percent of construction costs for Operation and Maintenance during the first two years.

Where curvature exceeds 5 degrees, bank slope protection in the form of rock rip-rap is planned. Velocities exceed 6.5 feet per second "aged" in only three reaches where considerable rock excavation was avoided.

Excavation will be done where possible from one bank only. This will enhance stability and reduce the temporary silt pollution of the stream by keeping one bank vegetated. As noted previously, this method of construction, as well as the presence of rock and cobbles will increase the overall "as built" roughness and will thereby prevent the "as built" velocities from reaching the extremes computed by using "n" values of 0.025.

Computations made in Fort Worth E&WP Unit indicate that the design will not give trouble from uneven flow conditions. It was found that the flow is in sub-critical range for "as built" conditions with an "n" value of 0.025, a slope of 0.0056 and a discharge of 1,240 cubic feet per second. The ratio of S_o to S_c is 0.66 S_c with the critical slope for this section being 0.0085. This channel is, therefore, outside the unstable range as given by the criteria 0.7 S_c S_o 1.3 S_c, with the gradient of 0.0056.

Forestry

A systematic field survey showed ground cover, forest and hydrologic condition, and treatment needs. This survey, supporting data, and information from other agencies and forestry officials determined the amount of remedial measures. The measures recommended contribute to flood reduction and soil stabilization.

Addenda 1

PROPOSED FISH & WILDLIFE STUDY

CYPRESS CREEK WATERSHED

Purpose of Study

In order to establish facts concerning the effect of watershed development on fish and wildlife resources, a before-and-after study will be made of the Cypress Creek Watershed. The Alabama Department of Conservation, Tennessee Game and Fish Commission, Florence State University, Bureau of Sport Fisheries and Wildlife, and the Soil Conservation Service, will participate in the cooperative study. Watershed sponsors have agreed to delay for three years installation of all structural measures in the watershed, except those measures on Little Cypress and its tributaries. This delay was agreed upon as being necessary to make a detailed before study of fish and wildlife resources.

Information obtained by this study will be valuable to the participating organizations and other groups and individuals who are concerned with retaining, developing, and managing fishery and wildlife resources. This information will be especially valuable to sponsors of watershed projects and to landowners within watershed projects. It will enable them to make more knowledgeable decisions regarding their fish and wildlife resources.

The fisheries study will be conducted on the Alabama portion of the watershed only. The wildlife study will be made on both the Alabama and Tennessee portions. Results of the wildlife studies will be combined to reflect overall watershed effects on wildlife resources.

Objectives of the Fisheries Study

The objectives of this study are as follows:

1. To determine the effects of channel improvement on indigenous fish populations of Cypress Creek Watershed.

2. To determine the effects of channel improvement on fishing activity and fishing success in Cypress Creek and its major tributaries.

3. To determine the effects of channel improvement on water temperatures in Cypress Creek and its major tributaries.

4. To determine the effects of fish-mitigating measures installed in Cypress Creek Watershed.

5. To determine the standing crops of fish in sediment pools of Cypress Creek Watershed.

6. To determine fishing activity and fishing success in sediment pools of Cypress Creek Watershed.

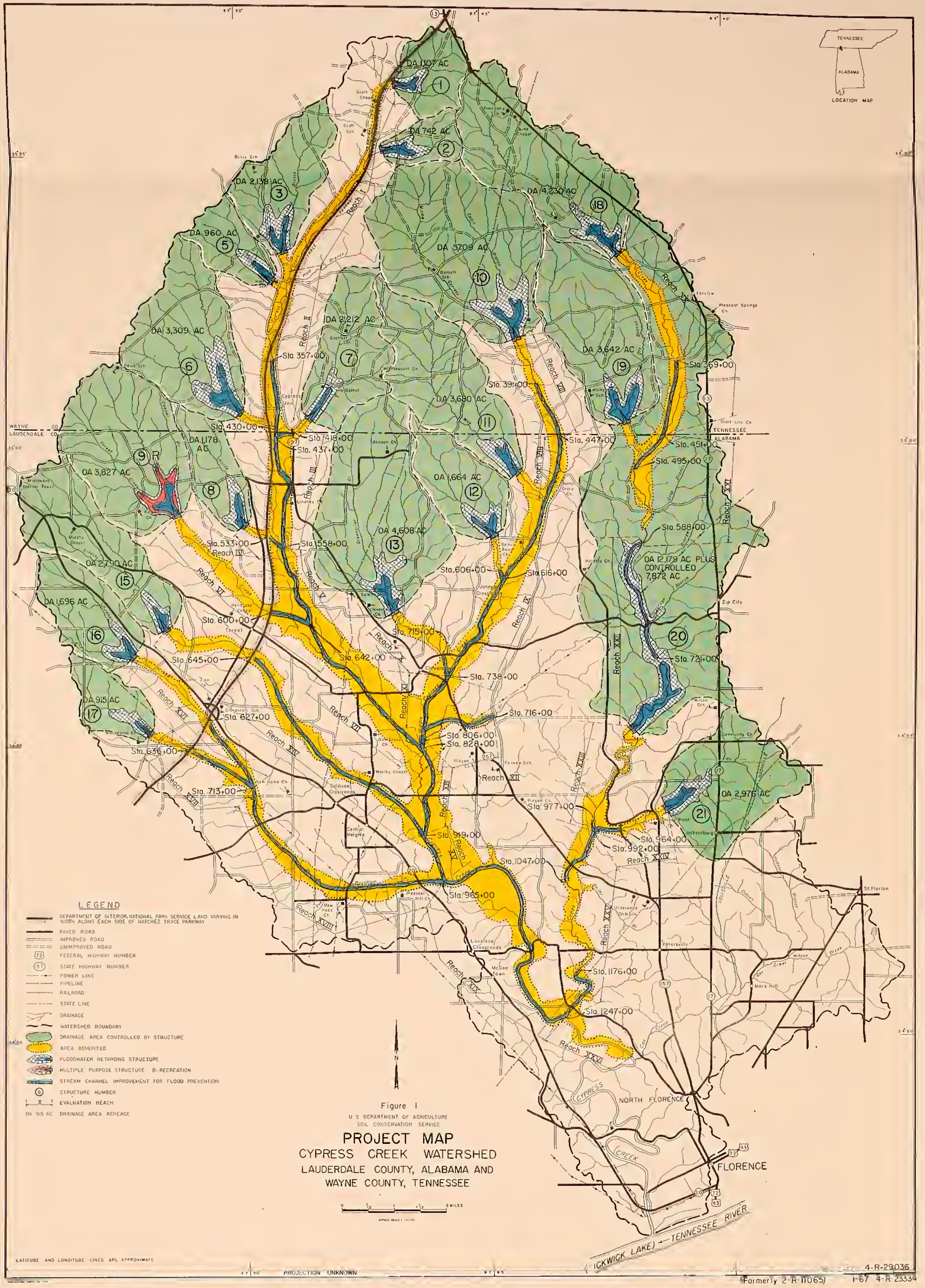

Figure 1

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT MAP
CYPRESS CREEK WATERSHED
LAUDERDALE COUNTY, ALABAMA AND WAYNE COUNTY, TENNESSEE

4-R-29036
(Formerly 2-R-11065) 1-67 4-R-23334